California Independent
System Operator Corporation

March 3, 2021

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

Re: California Independent System Operator Corporation
Docket No. ER21-____-000

Filing to Implement Variable Operations and Maintenance Cost Initiative and Request for Waiver of Notice Requirement

Dear Secretary Bose:

The California Independent System Operator Corporation (CAISO) submits this tariff amendment to implement tariff revisions arising from its variable operations and maintenance (O&M) initiative.[1] The tariff amendment changes the structure of how O&M costs are accounted for in the CAISO markets to ensure market participants' bids reflect these costs more accurately. In particular, the CAISO proposes to adopt a new framework for O&M cost recovery based on new O&M adders for start-up, minimum load, and energy costs. These adders will replace the existing adders for major maintenance expenses and variable O&M costs.

Stakeholders generally agreed with the proposals reflected in the tariff amendment. As discussed below, the CAISO respectfully requests the Commission accept one of the tariff revisions contained in this filing effective May 17, 2021, accept further tariff revisions effective January 1, 2022, and accept still other tariff revisions effective April 1, 2022. This staged implementation will ensure the CAISO and market participants have sufficient time to transition to the new O&M structure. Good cause exists for the Commission to waive its 120-day notice requirement to give the CAISO and market participants regulatory certainty and sufficient time to implement the tariff revisions.

[1] The CAISO submits this filing pursuant to section 205 of the Federal Power Act (FPA), 16 U.S.C. § 824d. References in this transmittal letter to section numbers are references to sections of the CAISO tariff unless otherwise stated.

I. Executive Summary

Based on the CAISO's most recent triennial review and update of variable O&M costs, the CAISO determined a more extensive review of the O&M cost framework and principles was necessary. The CAISO therefore undertook the stakeholder initiative that resulted in this tariff amendment.

The CAISO determined a more extensive review was needed based on several issues with the current cost recovery framework and process. Today market participants can receive two types of bid adders that reflect O&M costs in the CAISO markets: (1) adders for major maintenance expenses, which are negotiated between the CAISO and scheduling coordinators; and (2) adders for variable O&M costs, which can be either negotiated or set at default values specified in the tariff. Due to a lack of publicly available principles for the categorization of O&M costs, negotiating these adders can – and has – become overly complex and burdensome. The triennial review has also become challenging because there are no reference categories for the CAISO to evaluate the existing default variable O&M cost values. These issues impose significant administrative burdens on market participants and the CAISO.

This tariff amendment addresses the challenges facing the CAISO and market participants by changing how O&M costs are estimated and accounted for in the CAISO markets. The CAISO proposes to include in the tariff explicit principles for categorizing O&M costs to better differentiate between fixed and variable costs. Having a uniform understanding of these principles will facilitate simplified, less onerous negotiations between the CAISO and market participants. It also provides reference categories that alleviate the challenges faced by the CAISO during the triennial reviews of default O&M adder values. Further, the CAISO proposes a revised cost framework to which it will apply these updated principles. This framework will consist of O&M adders for start-up, minimum load, and energy costs, which will replace the adders for major maintenance expenses and variable O&M costs. This new framework will allow all variable O&M costs to be properly reflected in start-up costs, minimum load costs, and default energy bids. The new framework will provide greater flexibility to market participants and will allow them to more accurately reflect their costs based on the type of bid.

The CAISO also proposes to update the default values for O&M adders market participants can use in lieu of negotiated adders. This new framework estimates a default value for certain O&M costs that currently do not have default values and thus may eliminate the need for some market participants to engage in negotiations in the first place. These new default values are more precise than the current values, thereby increasing the efficiency of the market by ensuring bids into the CAISO markets are based on more accurate cost estimates.

The proposed tariff revisions will increase the flexibility available to market participants to reflect O&M costs in their bids, will improve the accuracy of default O&M adder values, and will decrease the administrative burden of negotiations. For these reasons and the others explained below, the Commission should accept the tariff revisions.

II. Background

A. Relevant CAISO Tariff Provisions

Under its tariff, the CAISO markets optimize economic commitment and dispatch of supply and demand resources based on submitted bids, including self-schedules and cost-based generated bids for resource adequacy resources, and other generally applicable bidding rules. These cost-based generated bids are also used in local market power mitigation.

1. Existing Tariff Rules for Commitment Costs

In the day-ahead market, (*i.e*., the integrated forward market (IFM) and the residual unit commitment (RUC) process), the CAISO commits long-start units through the IFM and RUC and publishes a financially binding day-ahead schedule along with Ancillary Services and RUC awards.[2] In making commitment decisions, the market separately considers the costs of starting up resources (start-up costs), the costs of running resources at their minimum operating levels (minimum load costs),[3] transition costs for resources that can operate in different configurations,[4] and the costs for producing energy above minimum load.

Supply resources have an established proxy cost for their start-up costs, minimum load costs, and transition costs based on the proxy cost methodology.[5]

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[2] Existing tariff section 31, *et seq.* In addition, the real-time market commits resources in the real-time unit commitment and short-term unit commitment processes every 15 minutes. Existing tariff section 34, *et seq.* For the sake of clarity, this transmittal letter distinguishes between existing tariff sections (*i.e.*, sections in the current CAISO tariff), new tariff sections (*i.e.*, new sections that the CAISO proposes to add to the tariff in this filing), revised tariff sections (*i.e.*, existing tariff sections that the CAISO proposes to revise in this filing), and deleted tariff sections (*i.e.*, existing tariff sections that the CAISO proposes to delete in this filing).

[3] *See* existing tariff section 31.3; tariff appendix A, existing definitions of "Start-Up Cost" and "Minimum Load Costs."

[4] The tariff refers to these resources as multi-stage generating (MSG) resources. *See* tariff appendix A, existing definition of "Multi-Stage Generating Resources." For an MSG resource, transition cost is the dollar cost per feasible transition from a given MSG configuration to a higher MSG configuration when the resource is already on. Tariff appendix A, existing definition of "Transition Cost."

[5] Existing tariff section 30.4.5. Under the CAISO tariff, resource commitment costs are calculated using either a defined "proxy cost" methodology or "registered cost" methodology, the

The term "proxy costs" refers an estimate of the resource's costs that includes a combination of resource-specific information discussed below, to approximate a resource's variable costs. Suppliers can bid commitment costs up to 125 percent of the proxy cost calculation.[6] To the extent resources do not recover the sum of their bid-in costs (*i.e.*, commitment costs and energy, ancillary services, and RUC costs) through the market, the resources can recover them through a bid cost recovery uplift payment.[7]

For proxy start-up costs and proxy minimum load costs, the bid-in cost components include adders for major maintenance expenses the CAISO and the scheduling coordinator can negotiate.[8] In addition, for proxy minimum load costs, the cost components include adders for variable O&M costs, which can be either default values specified in the tariff based on the fuel source or technology of the resource, or negotiated values.[9] Resources subject to the proxy cost methodology submit daily bids for their start-up costs, minimum load costs, and transition costs that are between zero and 125 percent of the calculated proxy cost (the proxy cost bid cap).[10]

latter methodology being available only to use-limited resources with fewer than 12 months of locational marginal pricing data. Existing tariff sections 30.4.1 – 30.4.2 and 30.4.7. The proxy cost methodology uses flexible daily commitment cost values while the registered cost methodology uses commitment cost values that are fixed every 30 days and registered in the CAISO's Master File. Registered costs are subject to a cap set at 150 percent of calculated projected proxy cost values. Existing tariff section 39.6.1.6.

6 Existing tariff sections 30.4.4.1 – 30.4.4.2; tariff appendix A, existing definition of "Commitment Cost Multiplier."

7 Existing tariff sections 30.4.5.1 – 30.4.5.2.

8 Existing tariff sections 30.4.5.1(e), 30.4.5.2(e), 30.4.5.4. If the negotiations are not successful, the scheduling coordinator has the right to file proposed major maintenance expense values with the Commission pursuant to section 205 of the FPA. Existing tariff section 30.4.5.4.3. In the event of a dispute regarding the reasonableness of the adder for major maintenance expenses determined by the CAISO, the CAISO will determine a reasonable interim adder value until the negotiations result in an agreement between the CAISO and the scheduling coordinator. Existing tariff section 30.4.5.4.4.

9 Existing tariff sections 30.4.5.1(c)(i), 30.4.5.2(c)(i), 39.7.1.1.2.

10 Existing tariff section 30.4.4.1; tariff appendix A, existing definition of "Commitment Cost Multiplier." Proxy costs calculated based on application of the proxy cost bid cap are sometimes called "commitment cost reference levels."

2. Existing Tariff Rules for Generated Default Energy Bids

The CAISO uses generated cost-based energy bids in the market, including as default energy bids to mitigate bids of resources subject to local market power mitigation.[11] If a market bid is subject to mitigation, the CAISO systems substitute the default energy bid for the resource's bid in the market clearing process and use the default energy bid to determine the resource's bid cost recovery compensation.[12] Default energy bids also factor into the settlement of residual imbalance energy and exceptional dispatches in some circumstances.[13]

For each resource, a scheduling coordinator can choose any of several options as its preferred option for calculating default energy bids, including the variable cost option.[14] For natural gas-fired resources subject to the variable cost option, the default energy bid includes the same default or negotiated adders for variable O&M costs that apply to proxy minimum load costs as discussed above.[15]

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[11] Existing tariff section 39.7.1, *et seq.* Default energy bids are sometimes called "energy reference levels." A resource's proxy costs calculated based on application of the proxy cost bid cap and default energy bids are sometimes collectively called the resource's "reference levels."

[12] Existing tariff section 11.8, *et seq.*

[13] Existing tariff sections 11.5.5, 11.5.6.

[14] Other default energy bid options are the negotiated rate option and the locational marginal price option. Existing tariff sections 39.7.1 – 39.7.1.3. Further, a scheduling coordinator for a frequently mitigated unit has a fourth option for calculating default energy bids, the frequently mitigated unit option. Existing tariff section 39.7.1.4. In addition, a scheduling coordinator for a hydroelectric resource with storage capability has a fifth option for calculating default energy bids, the hydro default energy bid option. Existing tariff section 39.7.1.7. The CAISO may also establish temporary default energy bids. Existing tariff section 39.7.1.5.

[15] Existing tariff sections 39.7.1.1 – 39.7.1.1.1 and 39.7.1.1.1.3 – 39.7.1.1.1.4. The CAISO also generates cost-based bids (*i.e.*, generated bids) using the same cost components and resource-specific information used to calculate the variable cost default energy bid when a supplier does not submit a bid for a resource adequacy resource subject to a must-offer obligation or the generally applicable scheduling and bidding rules specified in the CAISO tariff and the business practice manual. Existing tariff sections 30.7.3.4 and 40.6.8, *et seq.*; tariff appendix A, existing definition of "Generated Bid."

B. Reasons for This Tariff Amendment

The CAISO has reviewed the existing default variable O&M adder values on a triennial basis since 2012.[16] The CAISO performed an internal review of the adder values in 2015, but did not change them.

In 2018, the CAISO engaged an outside consultant, Nexant, to conduct a more extensive review of the adder values, which resulted in issuance of a report (Nexant Report) that included cost estimates to update the adder values.[17] The CAISO also held five working groups for different types of resource technologies with stakeholders in July 2019 to discuss the Nexant Report and O&M costs more broadly.[18] The discussion was informed by the recent proceeding regarding major maintenance costs in the energy and capacity markets of PJM Interconnection, L.L.C. (PJM).[19] In the working groups, the CAISO and stakeholders reviewed common maintenance activities to attempt to categorize these as major maintenance costs, non-major variable maintenance costs, or fixed maintenance costs. Through this process, stakeholders found that the CAISO's attempt to distinguish between major and non-major variable maintenance activities was challenging and possibly futile because such categories differ significantly across organizations. This observation led to the CAISO's development of a more comprehensive update to the O&M cost framework that would avoid the issues faced by PJM by eschewing a distinction between major and non-major variable maintenance costs.

Through the working groups, stakeholders also noted the CAISO did not have an explicit set of principles for determining whether costs are fixed or variable in nature.[20] For market participants, this can lead to challenges in applying for major maintenance adders and negotiated variable O&M adders. For the CAISO, this can cause difficulty in processing applications in a consistent

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16 *See Cal. Indep. Sys. Operator Corp.*, 134 FERC ¶ 61,257, at P 22 (2011) ("CAISO also notes that it did agree to review its current default adders on a three-year cycle and continues to make efforts to evaluate costs and improve its cost recovery options.").

17 Nexant issued version 1 of the Nexant Report in 2018 and the final version (version 2) of the Nexant Report in 2020 following CAISO stakeholder review. The final version of the Nexant Report is contained in Appendix F to the Final Proposal provided in attachment D to this filing as discussed below.

18 Materials related to the five working groups are available at California ISO - Documents By Group (caiso.com).

19 *PJM Interconnection, L.L.C.*, 167 FERC ¶ 61,030, at PP 42, 46 (2019) (*PJM*).

20 The CAISO notes that the core principle that O&M costs must be variable in nature (*i.e.*, varies depending on the number of start-up/shut-downs, number of run-hours, and energy output) has been used consistently in negotiations. However, the CAISO discussed this principle in its business practical manual, rather than in its tariff. As discussed in further detail below, this filing proposes to formalize this principle and others related to it in the tariff.

and efficient manner and in quantifying the cost components to update the default variable O&M adder values.

C. Stakeholder Process

In December 2019, the CAISO established a stakeholder initiative, called the Variable Operations and Maintenance Cost Review, to address the issues identified in the working groups and develop tariff revisions to the extent necessary. The stakeholder process took place over more than a year and included:

- The CAISO issuing a series of four policy papers;
- The development of draft and revised daft tariff provisions;
- Six conference calls with stakeholders to discuss the CAISO policy papers and draft tariff provisions; and
- Opportunities at each step of the initiative for stakeholders to submit written comments.[21]

The CAISO Governing Board (Board) authorized the preparation and filing of this tariff amendment at its November 18, 2020 meeting.[22]

Stakeholders for the most part agreed with the proposals reflected in the tariff amendment. The CAISO addresses specific issues raised by stakeholders below.[23]

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[21] Materials related to this stakeholder process are available at https://stakeholdercenter.caiso.com/StakeholderInitiatives/Variable-operations-maintenance-cost-review. The materials include the Final Proposal – Variable Operations and Maintenance Cost Review (Final Proposal) the CAISO issued in the stakeholder process, which is provided in attachment D to this filing. The CAISO also provides a list of key dates in the stakeholder process for this tariff amendment in attachment F to this filing.

[22] Materials related to the Board's authorization are available at http://www.caiso.com/informed/Pages/BoardCommittees/BoardGovernorsMeetings.aspx. The materials include a memorandum to the Board (Board Memorandum), which is provided in attachment E to this filing.

[23] *See infra* section IV of this transmittal letter.

III. Proposed Tariff Revisions

The CAISO proposes to adopt a revised framework for O&M cost recovery based on new variable O&M adders for start-up, minimum load, transition, and energy costs. These adders will replace the existing adders for major maintenance expenses and variable O&M costs.

To implement the new variable O&M adders, the CAISO proposes to revise and replace the existing tariff provisions on adders for major maintenance expenses for variable O&M costs as discussed below. Under the new tariff provisions, resources that satisfy the applicable fuel source and technology requirements will receive new default variable O&M adders that supersede and replace any default adders previously established for the resources. In addition, resources can negotiate new variable O&M adders. The CAISO will also convert existing negotiated values to new negotiated O&M adder values and provide scheduling coordinators the option to retain the converted adder values or negotiate further changes to them.[24]

The core principle specified in the tariff itself, is that only variable costs are considered in setting a resource's reference levels.[25] The CAISO's adherence to this core principle is consistent with the Commission's prior pronouncements on this subject.[26] The tariff revisions will enhance the existing O&M cost framework and principles for distinguishing between fixed costs and variable costs as discussed below.

A. Use of New Defined Terms to Implement the Variable O&M Adders

The CAISO proposes to define a new term variable O&M adder, which can mean either (1) a variable start-up O&M adder, (2) a variable minimum load O&M adder, or (3) a variable energy O&M adder.[27] The CAISO defines these

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[24] Any variable O&M adders reflected in generated bids for energy (*see supra* note 15) will be default variable or negotiated O&M adders pursuant to the tariff revisions contained in this filing.

[25] Fixed costs, which are not included in reference levels, include fixed maintenance, general and administrative, and other costs. Fixed maintenance costs are maintenance costs that do not vary with the electrical production (*i.e.*, the electrical output, run-hours, or start-up/shut-down) of a resource. General and administrative costs are non-maintenance costs incurred at a resource that do not vary with or relate to production (*i.e.*, electrical output, run-hours, or start-up) of the resource. Other costs include any other plant-specific costs that are fixed in nature.

[26] *PJM* at PP 42, 46; *Sw. Power Pool, Inc.*, 165 FERC ¶ 61,026, at PP 16-17 (2018) (*SPP*).

[27] Tariff appendix A, new definition of "Variable Operations and Maintenance Adder." Except where otherwise stated below, the tariff revisions contained in this filing will go into effect on January 1, 2022 and are shown in attachments B-1 (clean tariff sheets) and attachment B-2

three terms as, respectively, an adder to start-up costs, an adder to minimum load costs, and an adder to minimum load costs and to default energy bids calculated under the variable cost option. Each adder will be determined under the tariff revisions on default and negotiated adders discussed below, which will ensure, as explained below, that only variable rather than fixed costs are recoverable.[28] The CAISO also proposes to revise the existing tariff to reference the newly defined terms and allow resources to reflect these adders in, respectively, their proxy start-up costs, proxy minimum load costs, and default energy bids under the variable cost option.[29]

Resources will be able to receive adders for both operations costs and maintenance costs (*i.e.*, their variable costs) to their start-up costs, minimum load costs, and default energy bids calculated under the variable cost option.[30] In contrast, under the current tariff provisions, resources can receive adders for major maintenance expenses only to their start-up and minimum load costs, and can receive adders for variable O&M costs only to their minimum load costs and default energy bids under the variable cost option. As a result, market participants will have greater flexibility to reflect their O&M costs in the appropriate components of their bids, *i.e.*, start-up costs, minimum load costs (or transition costs for MSG resources), or energy above minimum load. Therefore, this new three-adder framework is just and reasonable and should be accepted for filing.

B. New Default Variable O&M Adders

All resources that satisfy the applicable fuel source and technology requirements specified in the tariff revisions to implement default variable O&M adders will receive the new, predetermined default adders listed therein, which were established pursuant to the robust processes discussed below. Effective January 1, 2022, these new default adders will supersede and replace any then-

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(red-lined document) hereto.

[28] Tariff appendix A, new definitions of "Variable Start-Up Operations and Maintenance Adder," "Variable Minimum Load Operations and Maintenance Adder," and "Variable Energy Operations and Maintenance Adder," respectively.

[29] Revised tariff sections 11.8.2.1.2(c)-(d), 11.8.3.1, 11.8.4.1, 30.4.5.1(b)(i) (with the existing provisions in that section being moved to new tariff section 30.4.5.1(b)(iv)), 30.4.5.1(c)(i), 30.4.5.2(c)(i); new tariff sections 30.4.5.1(c)(ii), 30.4.5.2(b)(i), 30.4.5.2(c)(ii).

[30] *See supra* notes 14-15 and accompanying text (describing the calculation of default energy bids under the variable cost option set forth in the existing tariff). For a natural gas-fired resource subject to the variable cost option, the default energy bid is based on incremental fuel costs, which are based on gas prices published in natural gas price indices. All default energy bids under the variable cost option include a 10 percent multiplier (*i.e.*, default energy bid multiplier) to the CAISO's calculated cost based on the gas price indices. Existing tariff section 39.7.1.1 *et seq.*

existing default adders.[31] Resources will have the option to use the predetermined default adders in lieu of negotiating their adders through the process described below, which some resources might find too onerous compared with automatically receiving the default adders.

The CAISO determined the proposed default values for variable operations costs and for variable maintenance costs using two robust and somewhat different processes.[32] First, the CAISO derived the proposed variable operations cost values for most types of resources after reviewing and evaluating data and findings from the Nexant Report.[33] As explained therein,[34] Nexant developed variable operations cost estimates by finding public sources, if possible, that included relevant information consistent with the definition of variable operations costs under the CAISO principles discussed below.[35] In cases where there was such data, the next step was to make appropriate adjustments, if required, to reflect the CAISO's requirement that default variable operations values reflect the variable operations costs generally applicable to each type of resource that has a significant market presence in the Western Interconnection.[36] In the few cases where that approach was not possible,

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[31] Revised tariff section 30.4.5.4.1; new tariff section 30.4.5.4.2; deleted tariff section 39.7.1.1.2. The same default adder values shown in new tariff section 30.4.5.4.2 are also listed in the table on pages 10-11 of the Final Proposal. The table lists $0 default adder values for technology types that do not have variable operations or variable maintenance costs (*e.g.*, solar-powered resources) or for which insufficient data exists to meet the CAISO's cost estimation principles (*e.g.*, variable maintenance costs for steam turbines). Resources with those technology types can negotiate their variable O&M adders with the CAISO. Final Proposal at 10, 12. The negotiated values will be just and reasonable because they will satisfy the negotiation principles discussed in the next section of this transmittal letter.

[32] The variable operations costs are reflected in the default variable energy O&M adders listed in tariff section 30.4.5.4.2, and the variable maintenance costs are reflected in the default start-up O&M adders and default minimum load O&M adders listed in the tariff section. Final Proposal at 10.

[33] The exception is that the CAISO alone determined the proposed default value for variable operations costs for wind-powered resources, based on a conservative CAISO estimate of variable royalty payments to the owners of the land on which wind-powered resources are located. The CAISO estimated the royalty payments as a percentage of gross revenues using multiple sources, primarily the New York State Energy Research and Development Authority, which indicated that using 3 percent of gross revenues yields a sufficiently conservative estimate. Final Proposal at 11 n.7 and 35.

[34] Nexant Report at 1, 8-9. The Nexant Report analyzed data from various sources issued over a number of years up to and including 2018. The sources of data included, for example, cost of new entry study reports issued by other independent system operators, Utility-Scale Solar Reports and Wind Technologies Market Reports issued by the United States Department of Energy, and Annual Energy Outlook Reports issued by the United States Energy Information Authority. *See* Nexant Report at 4-8.

[35] *See infra* section III.C of this transmittal letter.

[36] *See id.* (discussing the principle that these values must reflect variable costs).

Nexant estimated variable operations costs using aggregated O&M costs that were then partially disaggregated into variable operations and other costs based on engineering judgement. Finally, the variable operations costs, which represented data for years prior to 2018, were adjusted to be representative of the costs in 2019 – the target year for all variable operations cost values. Nexant developed these variable operations cost estimates with input from the CAISO and stakeholders,[37] thus ensuring the cost estimation process was publicly verifiable and robust.

Second, as explained in the Final Proposal,[38] the CAISO developed the proposed default values for variable maintenance costs using the following five-step methodology:

(1) The CAISO selected external sources of information based on their use of variable maintenance cost definitions similar to the definitions employed by the CAISO, their geographic applicability, their temporal applicability (meaning publication within the last 10 years), their appropriateness to technology used in the footprint of the CAISO and the CAISO's Energy Imbalance Market (EIM) in the Western Interconnection, and their credibility. The CAISO used the cost data from those sources to estimate variable maintenance costs after factoring in differences in costs arising from geographic and temporal differences.

(2) The CAISO determined which adder type ($/start, $/run-hour, or $/MWh) is most appropriate as a default value for each identified type of technology, based on which of these adder types is the primary driver of maintenance costs and which adder type for major maintenance expenses is currently most prevalent for that type of technology.

(3) The CAISO converted the estimated variable maintenance costs identified in step (1) to the appropriate adder types identified in step (2).

(4) The CAISO cross-validated (i) the converted variable maintenance cost amounts identified in step (3) against (ii) median values for approved adders for major maintenance expenses,[39] to determine default variable maintenance adder values that are the lower of (i)

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37 Nexant Report at 1, 10.

38 Final Proposal at 13-14, 24-29.

39 The CAISO used median values, rather than some other values such as the mean of approved adders for major maintenance expenses, to mitigate the impact of outlier major maintenance expense values. Final Proposal at 27.

and (ii). Using the lower of these two values is just and reasonable because it ensures the default variable maintenance adders are sufficiently conservative,[40] while still being sufficiently attractive for resources to use in lieu of going through the process for negotiating O&M adder values.

(5) The CAISO will calculate resource-specific default variable O&M adders by multiplying the default adder values calculated in step (4) by the resource's maximum normal capability, *i.e.*, its PMax.[41]

As with the variable operations cost estimates described above, the CAISO developed the variable maintenance cost estimates with significant input from stakeholders.

The Commission has found using cost estimates for different types of resources that participate in the CAISO markets to determine default O&M adders is just and reasonable.[42] For similar reasons, and given the robust process the CAISO used to develop these values, the Commission should accept the new default variable O&M adders proposed in this filing.

C. New Negotiated Variable O&M Adders

The tariff revisions give the scheduling coordinator for any resource the option to negotiate with the CAISO for resource-specific (and MSG configuration-specific) variable O&M adders that supersede or replace any default variable O&M adders the resource may receive under the tariff revisions that will go into

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[40] Ensuring the default O&M adder values are sufficiently conservative is important for several reasons. First, these values are used in local market power mitigation to ensure resources able to exercise local market power cannot bid above their costs. Proxy cost estimates greater than resources' costs would introduce a potential inefficiency into the market if these proxy costs clear the market. In addition, once the default adder values are in place, only resources with costs higher than those values likely will seek to negotiate their variable O&M adder values with the CAISO. If the default values are set too high, the CAISO will have no visibility into whether resources' actual costs exceed the default values.

[41] This multiplication process is specified in new tariff section 30.4.5.4.2 regarding default variable start-up O&M adders and default variable minimum load O&M adders (there is no such multiplication process for default variable energy O&M adders). For MSG resources, the CAISO will calculate those adders by multiplying the default adder values calculated in step (4) by the PMax of each MSG configuration to reflect the additional costs of wear and tear of operating that MSG configuration.

[42] *Cal. Indep. Sys. Operator Corp.*, 138 FERC ¶ 61,173, at P 4 (2012) ("We will accept CAISO's tariff revisions to establish new default VOM [variable operations and maintenance] values, which are based on the average VOM that is applied across a class of generators in CAISO's system. [The default VOM values] appropriately account[] for the difference in operations and maintenance costs by generation technology and fuel type. Accordingly, we find that CAISO's revisions are as just and reasonable.").

effect on January 1, 2022 as discussed above.[43] In the stakeholder process for this tariff amendment, the CAISO and stakeholders developed principles to be followed in negotiating variable O&M adders. These principles balance prescriptiveness, for situations where a clear line must be drawn to guide the negotiations, with flexibility, for situations where there is a diversity of practice in the electric industry.[44] The tariff revisions reflect these same negotiating principles, one set for operations costs and another for maintenance costs.

Specifically, the principles state any operations costs proposed for inclusion in the negotiated variable O&M adders must be variable operations costs, meaning the costs of consumables and other costs that vary directly with electrical production (*i.e.*, start-up/shut-down, run-hours, or electricity output) of a resource. Variable operations costs exclude maintenance costs, auxiliary power costs, greenhouse gas allowance prices, fuel costs, grid management charges, opportunity costs, and other excluded costs set forth in the business practice manual.[45]

Further, the principles state any maintenance costs proposed for inclusion in the negotiated variable O&M adders must be variable maintenance costs, meaning the costs associated with the repair, overhaul, replacement, or inspection of a resource that meet the following conditions: (i) the costs must vary with the electrical production (*i.e.*, start-up/shut-down, run-hours, or electricity output) of the resource; (ii) the costs should reflect future maintenance costs that are expected to be incurred within the service life of a major component of plant or equipment; (iii) the costs should be consistent with good utility practice; (iv) the costs should not effect a substantial betterment of the resource; and (v) if the item is a replacement, it cannot be a replacement of an existing major component of plant or equipment.[46]

These tariff revisions are fully consistent with the Commission's determinations in the prior *PJM* and *SPP* orders regarding the nature of the costs that are recoverable in variable cost energy market adders and mitigated offers.[47] The tariff revisions will provide for a clearer and more accurate accounting of O&M costs in the CAISO markets and require those costs to satisfy the principles described above. This will enhance the efficiency of the markets by decreasing the administrative burden of negotiations due to their being conducted using the defined and common set of principles set forth above.[48]

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43 Revised tariff section 30.4.5.4.1; new tariff section 30.4.5.4.3.1.

44 Final Proposal at 8-9, 17-24.

45 New tariff section 30.4.5.4.3.1(a).

46 New tariff section 30.4.5.4.3.1(b).

47 *PJM* at PP 36, 41-42, 46; *SPP* at PP 2, 12, 16-17.

48 The tariff revisions will also create no potential to allow sellers to double recover their

The CAISO proposes to retain the existing process set forth in the tariff for scheduling coordinators to seek changes to negotiated adders, with a few changes. First, the CAISO has updated the tariff provisions to reference negotiated variable O&M adders rather than negotiated adders for major maintenance expenses.[49]

Second, the CAISO has temporarily deleted the tariff provision stating the CAISO will notify the scheduling coordinator, within 15 calendar days of its receipt of information from the scheduling coordinator, whether the CAISO has sufficient and accurate information to determine reasonable negotiated adders.[50] The CAISO anticipates numerous market participants will wish to negotiate new O&M adders so that those adders will be in place when the framework proposed in this amendment goes into effect (January 1, 2022), or will seek to negotiate new adders shortly after implementation. Under these circumstances, it is impractical for the CAISO to commit to evaluating negotiated adder proposals in 15 days. Therefore, the CAISO proposes to remove this 15-day notification provision during the period May 17, 2021 to April 1, 2022. This will allow the CAISO and scheduling coordinators sufficient time to negotiate new variable O&M adders that will go into effect starting on January 1, 2022 or shortly thereafter.[51] Even with the temporary removal of an explicit 15-day notification requirement from the tariff during the transitional period, the CAISO will make every effort to continue to process negotiated adders under the currently effective tariff using the same business process. The CAISO will update its business practice manual to explain how proposals for adders and updates under the currently effective tariff will be handled using the existing business process to the extent possible, and how proposals for new adders with effective dates on or after January 1, 2022 will be handled.

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variable O&M costs, which was a concern addressed in the *PJM* and *SPP* orders. *See PJM* at PP 21, 26, 37, 39, 44-45; *SPP* at PP 12, 18. Unlike PJM, the CAISO has no capacity market, which means there can be no double recovery in energy and capacity markets operated by the CAISO. Further, the CAISO's Department of Market Monitoring will review all variable O&M adders to ensure there is no double recovery. In addition, as discussed below in section III.D of this transmittal letter, the CAISO will file the variable O&M adders with the Commission for informational purposes.

[49] Tariff section 30.4.5.4.3.2, as revised and renumbered in this filing.

[50] Tariff section 30.4.5.4.2, as revised in this filing effective May 17, 2021, contained in attachments A-1 (clean tariff sheet) and A-2 (red-lined document) hereto.

[51] The Final Proposal (at 32-34) outlines the CAISO's plan for negotiating new variable O&M adders with market participants in the months leading up to the effective date of the tariff revisions, which at the time the CAISO expected to be October 1, 2021. As explained in the Final Proposal (at 7, 32), the dates listed in the plan are illustrative and the CAISO could adjust them as needed, which the CAISO subsequently did.

Effective April 1, 2022, the CAISO will once again adhere to a 15-day review and notification period. However, the CAISO proposes to revise this provision to refer to business days rather than calendar days. This will ensure the CAISO has sufficient time to review information provided by scheduling coordinators, which can be challenging under a calendar day-based timeline when there are intervening weekends and holidays.[52] For the same reason, the CAISO proposes to change certain other references from calendar days to business days in the tariff provisions relating to adder negotiation effective April 1, 2022. Specifically, the CAISO proposes to change the time period for a scheduling coordinator to seek a change to its negotiated adder no sooner than 30 business days (rather than 30 calendar days as under the existing tariff) after the negotiated adder was determined, and to change the time period for the CAISO to determine a reasonable negotiated variable O&M adder to 10 business days (rather than 10 calendar days as under the existing tariff) after the CAISO confirms it has all the required information or it resolves a dispute with the scheduling coordinator. In addition, to provide sufficient time to implement negotiated variable O&M adders agreed upon following a dispute, the CAISO proposes to revise the tariff to give it three business days (rather than one business day as under the existing tariff) to implement the agreed-upon adders.[53]

Finally, the CAISO proposes to maintain the existing tariff process for the scheduling coordinator to file proposed adders with the Commission, following the 60-day negotiation period set forth in the tariff,[54] and to permit interim adders in certain circumstances pending dispute resolution.[55] The only change the CAISO proposes to these tariff provisions is to reference variable O&M adders rather than adders for major maintenance expenses.

D. Relocation of Existing Tariff Provisions

The CAISO proposes to move existing tariff provisions addressing (1) the renegotiation of adders and (2) informational filings of adders, from their current

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[52] Tariff section 30.4.5.4.3.2, as revised and renumbered in this filing effective April 1, 2022, contained in attachments C-1 (clean tariff sheet) and C-2 (red-lined document) hereto. Removal of the notification provision is consistent with the absence of a similar notification provision in the existing CAISO tariff provisions regarding negotiation of opportunity cost adders to commitment costs and default energy bids. *See* existing tariff section 30.4.6.3. Because the Commission has found it is just and reasonable for the CAISO not to include any notification provision for one type of negotiated commitment cost and default energy bid adder (namely, the opportunity cost adder), the CAISO believes it is also just and reasonable to temporarily remove the notification provision for a different type of negotiated commitment cost and default energy bid adder (the variable O&M adder).

[53] Tariff section 30.4.5.4.3.2, as revised and renumbered in this filing effective April 1, 2022, contained in attachments C-1 (clean tariff sheet) and C-2 (red-lined document) hereto.

[54] Tariff section 30.4.5.4.3.3 as revised and renumbered in this filing.

[55] Tariff section 30.4.5.4.3.4 as revised and renumbered in this filing.

location in the tariff regarding the calculation of default energy bids[56] to new tariff sections within the part of the tariff (section 30.4.5.4) regarding variable O&M adders.[57] This is the more logical place to locate these existing tariff provisions and should improve tariff accessibility for market participants.

E. Conversion of Existing Negotiated Values

The CAISO proposes to add tariff provisions addressing the conversion of existing negotiated values to new negotiated adder values.[58] Effective January 1, 2022, the CAISO will convert any existing adder values for major maintenance expenses established prior to that effective date and any existing negotiated O&M values previously established for a resource, into corresponding negotiated variable O&M adders with values equivalent to the previously established values. The CAISO will effectuate the conversions applying the principles identified above to ensure costs are properly assigned to the separate operations cost and maintenance cost adders.

Each scheduling coordinator for a resource for which the CAISO performs such conversions will subsequently have the option to either: (1) retain the corresponding variable O&M adders for the resource; (2) negotiate changes to all of the corresponding variable O&M adders for the resource pursuant to the tariff revisions discussed above;[59] or (3) negotiate changes to some of the corresponding variable O&M adders for the resource, and have the CAISO convert the balance of the corresponding variable O&M adders into default variable O&M adders pursuant to the tariff revisions discussed above.[60] Thus, the scheduling coordinator has flexibility to retain the corresponding adders or to negotiate changes to some or all of them.

F. Other Tariff Revisions

To reflect the implementation of the new tariff provisions, the CAISO proposes to delete existing tariff references to adders for major maintenance expenses, which will no longer exist.[61]

For reliability must-run (RMR) resources, major maintenance costs are set forth expressly in their RMR contracts rather than in the tariff. RMR resources

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[56] Revised tariff sections 39.7.1.3.2.1 – 39.7.1.3.2.2.

[57] New tariff sections 30.4.5.4.4 – 30.4.5.4.5.

[58] Revised tariff section 30.4.5.4.1; new tariff section 30.4.5.4.6.

[59] *See supra* section III.C of this transmittal letter.

[60] *See supra* section III.B of this transmittal letter.

[61] Revised tariff sections 11.8.2.1, 39.6.1.6, 39.6.1.6.3, 39.7.1.1; deleted tariff sections 30.4.5.1(c)(v), 30.4.5.1(e), 30.4.5.2(e).

are not subject to the tariff adders for major maintenance expenses or variable O&M costs. Therefore, the CAISO proposes to revise the tariff to specify that the tariff revisions will not apply to RMR resources.[62]

IV. Responses to Stakeholder Comments

Stakeholders broadly supported the CAISO's proposals in the Variable Operations and Maintenance Cost Review initiative. Some stakeholders raised specific concerns, which are as discussed below, but no stakeholder who provided comments generally opposed the proposal.

From a policy perspective, most comments focused on the proposed default O&M adder values and the specific wording of the O&M negotiation principles. One stakeholder expressed concern some of the proposed default values were too low compared with the stakeholder's internal cost estimates or were grouped in technology categories that are insufficiently granular. The CAISO understands default values may not reflect some specific resource conditions, but that does not render them unjust and unreasonable; nor are resources unduly prejudiced. They are merely default values, and resource owners are able to negotiate different values if they believe the default values do not sufficiently reflect the values for their individual resources. The CAISO developed the default values with input from stakeholders, and they are based on verifiable cost information. As explained above, they strike a reasonable balance between being sufficiently conservative to avoid causing market inefficiencies (or guaranteeing significant variable cost over-recovery for many resources) while also being useful for most of the participants' resources. Most importantly, market participants will still have the ability to negotiate O&M adder values if the default O&M adder values do not meet a specific resource's needs.[63]

Regarding the O&M negotiation principles, the CAISO incorporated stakeholder suggestions into the final language of the principles. For example, one stakeholder suggested revising the draft principles to include the term "substantial betterment" used by the Commission in its Uniform System of Accounts.[64] In response, the CAISO incorporated this language into the negotiation principles.[65]

From an implementation perspective, stakeholders focused their comments on the treatment of existing O&M adders and the initiative timeline. Several stakeholders noted negotiating their existing adders took considerable

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62 Revised tariff section 11.8.2.1.

63 *See supra* section III.B of this transmittal letter.

64 18 C.F.R. Part 101.

65 *See supra* section III.C of this transmittal letter.

time and effort and were concerned such effort would be wasted if they were required to renegotiate their adders following approval of the CAISO's proposal. The CAISO addressed this feedback by proposing to convert the existing negotiated values to new negotiated adder values.[66]

One stakeholder voiced a concern that the proposed tariff revisions initiative might become effective too soon to allow the CAISO and stakeholders sufficient time to implement them. To address this concern, the CAISO updated the target implementation date for most of the tariff revisions proposed in this filing from October 1, 2021 to January 1, 2022.

The CAISO's Department of Market Monitoring (DMM) also generally supports the initiative. This is significant because DMM currently acts as the CAISO's agent in negotiating O&M adders and has expertise in the area of O&M costs.

V. Effective Date and Request for Waiver

The CAISO respectfully requests the Commission: (1) accept the tariff revisions regarding the 15-day information review period[67] effective May 17, 2021 and April 1, 2022 as described above; and (2) accept the balance of the tariff revisions contained in this filing effective January 1, 2022.[68]

Granting the requested waiver of the 120-day notice requirement will give the CAISO and market participants regulatory certainty and sufficient time to prepare to implement the tariff revisions. Therefore, good cause exists for the Commission to grant the requested waiver.

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66 *See supra* section III.E of this transmittal letter.

67 *See supra* section III.C of this transmittal letter (discussing revisions to tariff section 30.4.5.4.3.2 as renumbered and revised in this filing).

68 Specifically, pursuant to section 35.11 of the Commission's regulations, 18 C.F.R. § 35.11, the CAISO respectfully requests waiver of the notice requirement contained in section 35.3(a)(1) of the Commission's regulations, 18 C.F.R. § 35.3(a)(1), to allow most of the tariff revisions to go into effect more than 120 days after submittal of this filing as described above.

VI. Communications

Pursuant to Rule 203(b)(3) of the Commission's Rules of Practice and Procedure,[69] the individuals listed below are to receive correspondence and other communications regarding this filing:

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VII. Service

The CAISO has served copies of this filing on the California Public Utilities Commission, the California Energy Commission, and all parties with scheduling coordinator agreements under the CAISO tariff. In addition, the CAISO has posted a copy of the filing on the CAISO website.

VIII. Contents of Filing

In addition to this transmittal letter, this filing includes the following attachments:

Attachment A-1	Clean CAISO tariff sheets incorporating the tariff amendment contained in this filing that will become effective May 17, 2021
Attachment A-2	Red-lined document showing the revision contained in the tariff amendment that will become effective May 17, 2021
Attachment B-1	Clean CAISO tariff sheets incorporating the tariff amendments contained in this filing that will become effective January 1, 2022
Attachment B-2	Red-lined document showing the revisions contained

[69] 18 C.F.R. § 385.203(b)(3).

	in the tariff amendments that will become effective January 1, 2022
Attachment C-1	Clean CAISO tariff sheets incorporating the tariff amendment contained in this filing that will become effective April 1, 2022
Attachment C-2	Red-lined document showing the revision contained in the tariff amendment that will become effective April 1, 2022
Attachment D	Final Proposal
Attachment E	Board Memorandum
Attachment F	List of key stakeholder dates for the stakeholder initiative

IX. Conclusion

For the reasons set forth in this filing, the CAISO requests that the Commission accept the tariff revisions contained in the filing effective as of the dates described herein.

Respectfully submitted,

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Attachment A-1

Clean Tariff

Tariff Revision Prior to Implementation of Variable Operations and Maintenance Tariff Revisions

The tariff language shown below will go into effect on May 17, 2021 and will be superseded by the changes to the same tariff section (as renumbered) contained in the Variable Operations and Maintenance tariff revisions that will go into effect on January 1, 2022

* * * * *

30.4.5.4.2 CAISO Processes

Scheduling Coordinators may submit updated resource-specific major maintenance information for purposes of seeking a change to any major maintenance adder, no sooner than thirty (30) days after a major maintenance adder has been determined. The CAISO will evaluate the information provided by Scheduling Coordinators, and may require Scheduling Coordinators to provide additional information, to enable the CAISO to determine reasonable adders for major maintenance expenses or to conduct audits of major maintenance expenses. The CAISO will notify the Scheduling Coordinator in writing whether it has sufficient and accurate information to determine reasonable major maintenance adders to be included in the Proxy Start-Up Cost or Proxy Minimum Load Cost calculations, or both. Within ten (10) days after providing written notification to the Scheduling Coordinator that the information is sufficient and accurate, the CAISO will determine the reasonable adder for major maintenance expenses to be included in the Proxy Start-Up Costs or Proxy Minimum Load Costs, or both, and will so inform the Scheduling Coordinator in writing.

In the event of a dispute regarding the sufficiency or accuracy of the information provided by the Scheduling Coordinator, the CAISO and the Scheduling Coordinator will enter a period of good faith negotiations that terminates sixty (60) days after the date the dispute began. If the CAISO and the Scheduling Coordinator resolve the dispute during the 60-day negotiation period, within ten (10) days of such agreement, the

CAISO will determine the reasonable adder for major maintenance expenses and will provide the adder to the Scheduling Coordinator in writing. If the CAISO and the Scheduling Coordinator fail to agree upon the sufficiency or accuracy of the information during the 60-day negotiation period, the Scheduling Coordinator has the right to petition FERC to resolve the dispute as to the sufficiency or accuracy of its information. In the event of a dispute regarding the CAISO's determination of adders for major maintenance expenses, the CAISO and the Scheduling Coordinator will enter a period of good faith negotiations that terminates sixty (60) days after the date the dispute began. If the CAISO and the Scheduling Coordinator resolve the dispute during the 60-day negotiation period, the agreed-upon values will be effective as of the first Business Day following the resolution date.

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Attachment A-2

Marked Tariff

Red-line for Tariff Revision Prior to Implementation of Variable Operations and Maintenance Tariff Revisions

The tariff revision shown below will go into effect on May 17, 2021 and will be superseded by the changes to the same tariff section (as renumbered) contained in the Variable Operations and Maintenance tariff revisions that will go into effect on January 1, 2022

* * * * *

30.4.5.4.2 CAISO Processes

Scheduling Coordinators may submit updated resource-specific major maintenance information for purposes of seeking a change to any major maintenance adder, no sooner than thirty (30) days after a major maintenance adder has been determined.

The CAISO will evaluate the information provided by Scheduling Coordinators, and may require Scheduling Coordinators to provide additional information, to enable the CAISO to determine reasonable adders for major maintenance expenses or to conduct audits of major maintenance expenses. ~~Within fifteen (15) days of receipt of the information or any requested additional information, t~~The CAISO will notify the Scheduling Coordinator in writing whether it has sufficient and accurate information to determine reasonable major maintenance adders to be included in the Proxy Start-Up Cost or Proxy Minimum Load Cost calculations, or both. Within ten (10) days after providing written notification to the Scheduling Coordinator that the information is sufficient and accurate, the CAISO will determine the reasonable adder for major maintenance expenses to be included in the Proxy Start-Up Costs or Proxy Minimum Load Costs, or both, and will so inform the Scheduling Coordinator in writing.

In the event of a dispute regarding the sufficiency or accuracy of the information provided by the Scheduling Coordinator, the CAISO and the Scheduling Coordinator will enter a period of good faith negotiations that terminates sixty (60) days after the date the dispute began. If the CAISO and the Scheduling Coordinator resolve the dispute

during the 60-day negotiation period, within ten (10) days of such agreement, the CAISO will determine the reasonable adder for major maintenance expenses and will provide the adder to the Scheduling Coordinator in writing. If the CAISO and the Scheduling Coordinator fail to agree upon the sufficiency or accuracy of the information during the 60-day negotiation period, the Scheduling Coordinator has the right to petition FERC to resolve the dispute as to the sufficiency or accuracy of its information. In the event of a dispute regarding the CAISO's determination of adders for major maintenance expenses, the CAISO and the Scheduling Coordinator will enter a period of good faith negotiations that terminates sixty (60) days after the date the dispute began. If the CAISO and the Scheduling Coordinator resolve the dispute during the 60-day negotiation period, the agreed-upon values will be effective as of the first Business Day following the resolution date.

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Attachment B-1

Clean Tariff

Variable Operations and Maintenance Tariff Revisions

All the tariff language shown below will be effective on January 1, 2022

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11.8.2.1 IFM Bid Cost Calculation

For each Settlement Interval, the CAISO shall calculate IFM Bid Cost for each Bid Cost Recovery Eligible Resource as the algebraic sum of the IFM Start-Up Cost, IFM Transition Cost, IFM Minimum Load Cost, IFM Pump Shut-Down Cost, IFM Energy Bid Cost, IFM Pumping Cost, and IFM AS Bid Cost. For Multi-Stage Generating Resources, in addition to the specific IFM Bid Cost rules described in Section 11.8.2.1, the CAISO will apply the rules described in Section 11.8.1.3 to further determine the applicable MSG Configuration-based CAISO Market Start-Up Bid Cost, Transition Bid Cost, and Minimum Load Bid Cost in any given Settlement Interval. For Multi-Stage Generating Resources, the incremental IFM Start-Up Costs, IFM Minimum Load Costs, and IFM Transition Costs to provide Energy Scheduled in the Day-Ahead Schedule or awarded RUC or Ancillary Service capacity for an MSG Configuration other than the self-scheduled MSG Configuration are determined by the IFM rules specified in Section 31.3. For RMR Resources, the CAISO shall calculate the IFM Bid Cost as the algebraic sum of the IFM Start-Up Cost adjusted to remove Opportunity Costs, IFM Transition Cost adjusted to remove Opportunity Costs, IFM Minimum Load Costs adjusted to remove Opportunity Costs, IFM Energy Bid Cost adjusted to remove Opportunity Costs, and IFM AS Bid Cost. The CAISO will also adjust the IFM Bid Costs for RMR Resources, to remove any bid adder that includes costs that were recovered under the RMR Contract.

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11.8.2.1.2 IFM Minimum Load Cost

The IFM Minimum Load Cost for the applicable Settlement Interval shall be the Minimum Load Bid Cost applicable to the Integrated Forward Market, divided by the number of Settlement Intervals in a Trading Hour subject to the rules described below.

(a) For each Settlement Interval, only the IFM Minimum Load Cost in a CAISO IFM Commitment Period is eligible for Bid Cost Recovery.

(b) The IFM Minimum Load Cost for any Settlement Interval is zero if: (1) the Settlement Interval is in an IFM Self Commitment Period for the Bid Cost Recovery Eligible Resource; or (2) the Bid Cost Recovery Eligible Resource is manually pre-dispatched under a Legacy RMR Contract prior to the Day-Ahead Market or the resource is flagged as an RMR Dispatch in the Day-Ahead Schedule for the applicable Settlement Interval.

(c) If the CAISO commits a Bid Cost Recovery Eligible Resource in the Day-Ahead and the resource receives a Day-Ahead Schedule and the CAISO subsequently de-commits the resource in the Real-Time Market, the IFM Minimum Load Costs are subject to the Real-Time Performance Metric for each case specified in Section 11.8.4.4. If the CAISO commits an RMR Resource in the Day-Ahead and the resource receives a Day-Ahead Schedule and the CAISO subsequently de-commits the resource in the Real-Time Market, the sum of IFM Minimum Load Costs, adjusted to

remove Minimum Load Opportunity Costs and Variable Minimum Load Operations and Maintenance Adders, are subject to the Real-Time Performance Metric for each case specified in Section 11.8.4.4.

(d) If a Multi-Stage Generating Resource is committed by the CAISO and receives a Day-Ahead Schedule and subsequently is committed by the CAISO to a lower MSG Configuration where its Minimum Load capacity as registered in the Master File in the Real-Time Market is lower than the CAISO IFM Commitment Period MSG Configuration's Minimum Load as registered in the Master File, the resource's IFM Minimum Load Costs are subject to the Real-Time Performance Metric for each case specified in Section 11.8.4.4. If the CAISO commits an RMR Multi-Stage Generating Resource in the Day-Ahead and the resource receives a Day-Ahead Schedule and the CAISO subsequently de-commits the resource in the Real-Time Market, the sum of IFM Minimum Load Costs, adjusted to remove Minimum Load Opportunity Costs and Variable Minimum Load Operations and Maintenance Adders, are subject to the Real-Time Performance Metric for each case specified in Section 11.8.4.4.

(e) If the conditions in Sections 11.8.2.1.2 (c) and (d) do not apply, then the IFM Minimum Load Cost for any Settlement Interval is zero if the Bid Cost Recovery Eligible Resource is determined to be Off during the applicable Settlement Interval. For the purposes of determining IFM Minimum Load Cost, a Bid Cost Recovery Eligible Resource is assumed to be On if its metered Energy in a Settlement Interval is equal to or greater than the

difference between its (i) Minimum Load as registered in the Master File, or if applicable, as modified pursuant to Section 9.3.3, and (ii) the Tolerance Band, and the Metered Energy is greater than zero (0) MWh. Otherwise, such resource is determined to be Off.

(f) For Multi-Stage Generating Resources, the commitment period is determined based on application of section 11.8.1.3. If application of section 11.8.1.3 dictates that the IFM is the Commitment Period, then the calculation of the IFM Minimum Load Costs will depend on whether the IFM committed MSG Configuration is determined to be On. If it is determined to be On, then, the IFM Minimum Load Costs will be based on the Minimum Load Bid Costs of the IFM committed MSG Configuration. For the purposes of determining IFM Minimum Load Cost for a Multi-Stage Generating Resource, a Bid Cost Recovery Eligible Resource is determined to be On if its metered Energy in a Settlement Interval is equal to or greater than the difference between its IFM MSG Configuration Minimum Load as registered in the Master File, or if applicable, as modified pursuant to Section 9.3.3, and the Tolerance Band, and the Metered Energy is greater than zero (0) MWh. Otherwise, such resource is determined to be Off.

(g) The IFM Minimum Load Costs calculation is subject to the Shut-Down State Variable and is disqualified as specified in Section 11.17.2.

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11.8.3.1 RUC Bid Cost Calculation

For each Settlement Interval, the CAISO shall determine the RUC Bid Cost for a Bid Cost Recovery Eligible Resource as the algebraic sum of the RUC Start-Up Cost, RUC Transition Cost, RUC Minimum Load Cost, and RUC Availability Bid Cost. For Multi-Stage Generating Resources, in addition to the specific RUC Bid Cost rules described in Section 11.8.3.1, the rules described in Section 11.8.1.3 will be applied to further determine the applicable MSG Configuration-based CAISO Market Start-Up Bid Costs, Transition Bid Costs, and Minimum Load Bid Costs. For Multi-Stage Generating Resources, the incremental RUC Start-Up Costs, RUC Minimum Load Costs, and RUC Transition Costs to provide RUC awarded capacity for an MSG Configuration other than the self-scheduled MSG Configuration are determined by the RUC optimization rules in specified in Section 31.5. For each Settlement Interval, the CAISO shall determine the RUC Bid Cost for an RMR Resource as the algebraic sum of the RUC Start-Up Cost adjusted to remove Opportunity Costs and Variable Start-Up Operations and Maintenance Adders, and RUC Transition Cost adjusted to remove Opportunity Costs and Variable Start-Up Operations and Maintenance Adders.

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11.8.4.1 RTM Bid Cost Calculation

For each Settlement Interval, the CAISO shall calculate RTM Bid Cost for each Bid Cost Recovery Eligible Resource, as the algebraic sum of the RTM Start-Up Cost, RTM

Minimum Load Cost, RTM Transition Cost, RTM Pump Shut-Down Cost, RTM Energy Bid Cost, RTM Pumping Cost and RTM AS Bid Cost. For each Settlement Interval, the CAISO shall calculate RTM Bid Cost for each RMR Resource as the algebraic sum of the RTM Start-Up Cost adjusted to remove Opportunity Costs and Variable Start-Up Operations and Maintenance Adders, RTM Transition Costs adjusted to remove Opportunity Costs and Variable Start-Up Operations and Maintenance Adders, RTM Energy Bid Cost adjusted to remove Opportunity Costs and Variable Energy Operations and Maintenance Adders, and RTM AS Bid Cost. For Multi-Stage Generating Resources, in addition to the specific RTM Bid Cost rules described in Section 11.8.4.1, the rules described in Section 11.8.1.3 will be applied to further determine the applicable MSG Configuration-based CAISO Market Start-Up Bid Cost, Transition Bid Cost, and Minimum Load Bid Cost, in a given Settlement Interval. For Multi-Stage Generating Resources, the incremental RTM Start-Up Cost, RTM Minimum Load Cost, and RTM Transition Cost to provide RTM committed Energy or awarded Ancillary Services capacity for an MSG Configuration other than the self-scheduled MSG Configuration are determined by the RTM optimization rules in specified in Section 34.

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30.4.5 Proxy Cost Methodology

The CAISO will calculate Proxy Costs as described in this Section 30.4.5.

30.4.5.1 Natural Gas-Fired Resources

For each natural gas-fired resource, the CAISO will calculate a resource's Proxy Costs

based on the resource's actual unit-specific performance parameters and applicable gas prices as described below.

(a) **Fuel Input.** The CAISO will calculate Proxy Costs using formulaic natural gas cost values adjusted for fuel-cost variation, based on the natural gas price calculated pursuant to Section 39.7.1.1.1.3, and consistent with the requirements specified below.

(b) **Proxy Start-Up Cost.** Proxy Start-Up Costs will also include:

(i) a Variable Start-Up Operations and Maintenance Adder as provided in Section 30.4.5.4;

(ii) a greenhouse gas cost adder for each resource located within the CAISO Balancing Authority Area or an EIM Entity Balancing Authority Area within California, and registered with the California Air Resources Board as having a greenhouse gas compliance obligation, which is calculated for each Start-Up as the product of the resource's fuel requirement per Start-Up, the greenhouse gas emissions rate authorized by the California Air Resources Board, and the applicable Greenhouse Gas Allowance Price;

(iii) the rates for the Market Services Charge and System Operations Charge multiplied by the shortest Start-Up Time listed for the resource in the Master File, multiplied by the PMin of the resource as registered in the Master File, multiplied by 0.5; and

(iv) the cost of auxiliary power calculated using the unit-specific MWh quantity of auxiliary power used for Start-Up multiplied by a resource-specific electricity price.

(c) **Proxy Cost Minimum Load Costs.** Proxy Cost Minimum Load Costs will also include:

(i) a Variable Energy Operations and Maintenance Adder as provided in Section 30.4.5.4;

(ii) a Variable Minimum Load Operations and Maintenance Adder as provided in Section 30.4.5.4.

(iii) a greenhouse gas cost adder for each resource located within the CAISO Balancing Authority Area or an EIM Entity Balancing Authority Area within California, and registered with the California Air Resources Board as having a greenhouse gas compliance obligation, which is calculated for each run-hour as the product of the resource's fuel requirement at Minimum Load as registered in the Master File, the greenhouse gas emissions rate authorized by the California Air Resources Board, and the applicable Greenhouse Gas Allowance Price;

(iv) the rates for the Market Services Charge and System Operations Charge multiplied by the PMin of the resource as registered in the Master File; and

(v) the Bid Segment Fee.

(d) **Proxy Transition Costs.** For each Multi-Stage Generating Resource under the Proxy Cost methodology, the CAISO will calculate the Proxy Transition Costs utilized for each feasible transition from a given MSG Configuration to a higher MSG Configuration based on the difference between the Proxy Start-Up Costs for the higher MSG Configuration, and the Proxy Start-Up Costs for the lower MSG Configuration, as those costs are determined in accordance with the Proxy Start-Up Cost calculation methodology set forth in Section 30.4.5. If the result of this calculation is negative for any transition between two MSG Configurations, then the associated Proxy Transition Cost shall be zero.

30.4.5.2 Non-Natural Gas-Fired Resources

For each non-natural gas-fired resource, the CAISO shall calculate the Proxy Start-Up Cost and Proxy Minimum Load Cost values under the Proxy Cost methodology as specified below.

(a) **Fuel Input.** The Scheduling Coordinator for the resource will provide the fuel or fuel-equivalent input costs, which the CAISO will maintain in the Master File, pursuant to Section 39.7.1.1.1.2.

(b) **Proxy Start-Up Costs.** Proxy Start-Up Costs will also include, if applicable:

(i) a Variable Start-Up Operations and Maintenance Adder as

provided in Section 30.4.5.4;

(ii) greenhouse gas allowance costs for each resource located within the CAISO Balancing Authority Area or an EIM Entity Balancing Authority Area within California, and registered with the California Air Resources Board as having a greenhouse gas compliance obligation, as provided to the CAISO by the Scheduling Coordinator;

(iii) the rates for the Market Services Charge and System Operations Charge multiplied by the shortest Start-Up Time listed for the resource in the Master File, multiplied by the PMin of the resource as registered in the Master File, multiplied by 0.5.

(c) **Proxy Minimum Load Costs.** Proxy Minimum Load Costs will also include, if applicable:

(i) a Variable Energy Operation and Maintenance Adder as provided in Section 30.4.5.4 multiplied by the PMin of the resource or MSG Configuration of the resource as registered in the Master File;

(ii) a Variable Minimum Load Operations and Maintenance Adder as provided in Section 30.4.5.4;

(iii) greenhouse gas allowance costs for each resource located within the CAISO Balancing Authority Area or an EIM Entity Balancing Authority Area within California, and registered with the California Air Resources Board as having a greenhouse gas compliance obligation, as provided to the CAISO by the Scheduling

Coordinator;

(iv) the rates for the Market Services Charge and System Operations Charge multiplied by the PMin of the resource as registered in the Master File; and

(v) the Bid Segment Fee.

(d) **Proxy Transition Costs.** For each Multi-Stage Generating Resource under the Proxy Cost methodology, the CAISO will calculate the Proxy Transition Costs utilized for each feasible transition from a given MSG Configuration to a higher MSG Configuration based on the difference between the Proxy Start-Up Costs for the higher MSG Configuration, and the Proxy Start-Up Costs for the lower MSG Configuration, as those costs are determined in accordance with the Proxy Start-Up Cost calculation methodology set forth in Section 30.4.5. If the result of this calculation is negative for any transition between two MSG Configurations, then the associated Proxy Transition Cost shall be zero.

30.4.5.3 Multi-Stage Generating Resources

30.4.5.3.1 Application of Proxy Costs

For Multi-Stage Generating Resources under the Proxy Cost methodology, the CAISO will apply the Proxy Cost methodology to all the MSG Configurations. The Proxy Costs for Multi-Stage Generating Resources will be calculated for each specific MSG Configuration, including for each MSG Configuration that cannot be directly started.

30.4.5.3.2 Insufficient Information

Notwithstanding the rules set forth in Sections 30.4.5.1 and 30.4.5.2, to the extent that a

Scheduling Coordinator for a Multi-Stage Generating Resource, other than in its lowest configuration in which the Multi-Stage Generating Resource can be started, does not provide sufficient data for the CAISO to determine a component of the Proxy Start-Up Costs or Proxy Minimum Load Costs for a particular MSG Configuration, the CAISO will, if feasible, use the value for that component associated with the next-lowest MSG Configuration.

30.4.5.4 Variable Operations and Maintenance Adders

30.4.5.4.1 Generally

Each resource that satisfies the applicable fuel source and technology requirements set forth in Section 30.4.5.4.2 will receive the default Variable Operations and Maintenance Adders specified thereunder. The Scheduling Coordinator for any resource may choose to negotiate with the CAISO pursuant to Section 30.4.5.4.3 for negotiated Variable Operations and Maintenance Adders that supersede or replace any default Variable Operations and Maintenance Adders the resource may receive. Variable Operations and Maintenance Adders are subject to renegotiation pursuant to Section 30.4.5.4.4 and to informational filings pursuant to Section 30.4.5.4.5. Pursuant to Section 30.4.5.4.6, the CAISO will convert negotiated operations and maintenance values that were established for a resource prior to January 1, 2022 into corresponding negotiated Variable Operations and Maintenance Adders.

30.4.5.4.2 Default Variable Operations and Maintenance Adders

The default Variable Start-Up Operations and Maintenance Adder for a frame combustion turbine resource will equal $52.13 per start per MW multiplied by the PMax of the resource or MSG Configuration of the resource.

The default Variable Minimum Load Operations and Maintenance Adder will vary by fuel source or technology as follows: (1) for a natural gas-fired combined cycle resource, the adder will equal $1.74 per run-hour per MW multipled by the PMax of the resource or MSG Configuration of the resource; (2) for an aeroderivative combustion turbine resource, the adder will equal $4.38 per run-hour per MW multiplied by the PMax of the resource or MSG Configuration of the resource; and (3) for a hydroelectric resource, the adder will equal $0.65 per run-hour per MW multiplied by the PMax of the resource or MSG Configuration of the resource.

The default Variable Energy Operations and Maintenance Adder will vary by fuel source or technology as follows: (1) nuclear $1.08/MWh; (2) coal $2.69/MWh; (3) wind $0.28/MWh; (4) natural gas-fired combined cycle units $0.59/MWh; (5) steam units $0.33/MWh; (6) geothermal $1.16/MWh; (7) landfill gas $1.21/MWh; (8) frame combustion turbines $0.97/MWh; (9) aeroderivative combustion turbines $2.15/MWh; (10) reciprocating internal combustion engines $1.10/MWh; and (11) biomass $1.65/MWh.

Effective January 1, 2022, default adders established pursuant to this Section 30.4.5.4.2 will supersede and replace any then-existing default adders established prior to that effective date.

30.4.5.4.3 Negotiated Variable Operations and Maintenance Adders

30.4.5.4.3.1 Principles

The CAISO will negotiate resource-specific and MSG Configuration-specific Variable Operations and Maintenance Adders with a Scheduling Coordinator based on the

following principles:

(a) Any operations costs proposed for inclusion in the Variable Operations and Maintenance Adders must be variable operations costs, meaning the costs of consumables and other costs that vary directly with electrical production (*i.e.*, Start-Up/Shut-Down, run-hours, or electricity output) of a resource. Variable operations costs exclude maintenance costs, auxiliary power costs, Greenhouse Gas Allowance Prices, fuel costs, grid management charges, Opportunity Costs, and other excluded costs set forth in the Business Practice Manual.

(b) Any maintenance costs proposed for inclusion in the Variable Operations and Maintenance Adders must be variable maintenance costs, meaning the costs associated with the repair, overhaul, replacement, or inspection of a resource that meet the following conditions:

(i) The costs must vary with the electrical production (*i.e.*, Start-Up/Shut-Down, run-hours, or electricity output) of the resource.

(ii) The costs should reflect future maintenance costs that are expected to be incurred within the service life of a major component of plant or equipment.

(iii) The costs should be consistent with Good Utility Practice.

(iv) The costs should not effect a substantial betterment of the resource.

(v) If the item is a replacement, it cannot be a replacement of an existing major component of plant or equipment.

30.4.5.4.3.2 CAISO Processes

Scheduling Coordinators may submit updated resource-specific and MSG Configuration-specific information for purposes of seeking a change to any negotiated Variable Operations and Maintenance Adder, no sooner than thirty (30) days after a negotiated Variable Operations and Maintenance Adder has been determined. The CAISO will evaluate the information provided by Scheduling Coordinators, and may require Scheduling Coordinators to provide additional information, to enable the CAISO to determine reasonable negotiated Variable Operations and Maintenance Adders or to conduct audits of negotiated Variable Operations and Maintenance Adders.

The CAISO will notify the Scheduling Coordinator in writing whether it has sufficient and accurate information to determine reasonable negotiated Variable Operations and Maintenance Adders to be included in the calculations for the Proxy Start-Up Cost, Proxy Minimum Load Cost, and/or Default Energy Bid under the Variable Cost Option. Within ten (10) days after providing written notification to the Scheduling Coordinator that the information is sufficient and accurate, the CAISO will determine the reasonable negotiated Variable Operations and Maintenance Adders to be included in the Proxy Start-Up Costs, Proxy Minimum Load Costs, and/or Default Energy Bids under the Variable Cost Option, and will so inform the Scheduling Coordinator in writing.

In the event of a dispute regarding the sufficiency or accuracy of the information provided by the Scheduling Coordinator, the CAISO and the Scheduling Coordinator will enter a period of good-faith negotiations that terminates sixty (60) days after the date the dispute began. If the CAISO and the Scheduling Coordinator resolve the dispute during the 60-day negotiation period, within ten (10) days of such agreement, the

CAISO will determine the reasonable negotiated Variable Operations and Maintenance Adders and will provide the adders to the Scheduling Coordinator in writing. If the CAISO and the Scheduling Coordinator fail to agree upon the sufficiency or accuracy of the information during the 60-day negotiation period, the Scheduling Coordinator has the right to petition FERC to resolve the dispute as to the sufficiency or accuracy of its information.

In the event of a dispute regarding the CAISO's determination of Variable Operations and Maintenance Adders, the CAISO and the Scheduling Coordinator will enter a period of good-faith negotiations that terminates sixty (60) days after the date the dispute began. If the CAISO and the Scheduling Coordinator resolve the dispute during the 60-day negotiation period, the agreed-upon negotiated Variable Operations and Maintenance Adders will be effective as of the first Business Day following the resolution date.

30.4.5.4.3.3 FERC Processes

If the CAISO and the Scheduling Coordinator fail to agree on the Variable Operations and Maintenance Adders for the Proxy Start-Up Costs, Proxy Minimum Load Costs, and/or Default Energy Bids under the Variable Cost Option following the 60-day negotiation period, the Scheduling Coordinator has the right to file proposed values and supporting information for the adders with FERC pursuant to Section 205 of the Federal Power Act.

30.4.5.4.3.4 Interim Variable Operations and Maintenance Adders Pending Dispute Resolution

In the event of a dispute regarding the reasonableness of the Variable Operations and Maintenance Adders determined by the CAISO, but not a dispute regarding the

sufficiency or accuracy of the information provided by the Scheduling Coordinator, the CAISO will determine reasonable interim Variable Operations and Maintenance Adders until the adders are determined by agreement between the CAISO and the Scheduling Coordinator or by FERC. Any subsequent agreement or FERC order determining the Variable Operations and Maintenance Adders will be reflected in an adjustment to the interim Variable Operations and Maintenance Adders in the next applicable Settlement Statement.

30.4.5.4.4 Renegotiation of Variable Operations and Maintenance Adders

The CAISO may require the renegotiation of any negotiated or interim Variable Operations and Maintenance Adders established pursuant to Section 30.4.5.4.3 that have become outdated, are possibly erroneous, or for which the Scheduling Coordinator has changed. In the renegotiation process, the CAISO may review and propose modifications to such Variable Operations and Maintenance Adders, and may require the Scheduling Coordinator to provide updated information to support their continuation.

30.4.5.4.5 Informational Filings

The CAISO shall make an informational filing with FERC of any default Variable Operations and Maintenance Adders established pursuant to Section 30.4.5.4.2 and any negotiated or interim Variable Operations and Maintenance Adders established pursuant to Section 30.4.5.4.3, no later than seven (7) days after the end of the month for which the Variable Operations and Maintenance Adders were established.

30.4.5.4.6 Conversion of Existing Negotiated Values

Notwithstanding any other provision in this Section 30.4.5.4, effective January 1, 2022, the CAISO will convert any then-existing adder values for major maintenance expenses

previously established for a resource pursuant to Section 30.4.5.4 (or any predecessor of that Section), and will convert any then-existing negotiated operations and maintenance values previously established for a resource pursuant to Section 39.7.1.1.2 (or any predecessor of that Section), into corresponding negotiated Variable Operations and Maintenance Adders with values equivalent to the previously established values. Each Scheduling Coordinator for a resource for which the CAISO performs such conversions will subsequently have the option to either: (1) retain the corresponding Variable Operations and Maintenance Adders for the resource; (2) negotiate changes to all of the corresponding Variable Operations and Maintenance Adders for the resource pursuant to Section 30.4.5.4.3; or (3) negotiate changes to some of the corresponding Variable Operations and Maintenance Adders for the resource pursuant to Section 30.4.5.4.3, and have the CAISO convert the balance of the corresponding Variable Operations and Maintenance Adders into default Variable Operations and Maintenance Adders pursuant to Section 30.4.5.4.2.

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39.6.1.6 Maximum Start-Up Cost and Minimum Load Cost Registered Cost Values

The maximum Start-Up Cost and Minimum Load Cost values registered in the Master File by Scheduling Coordinators for capacity of non-Multi-Stage Generating Resources that are eligible and elect to use the Registered Cost methodology in accordance with Section 30.4 cannot exceed the Minimum Load Cost Hard Cap and will be limited to one hundred fifty percent (150%) of the Projected Proxy Cost. The maximum Start-Up Cost

and Minimum Load Cost values registered in the Master File by Scheduling Coordinators for capacity of Multi-Stage Generating Resources that are eligible and elect to use the Registered Cost methodology in accordance with Section 30.4 will be limited to one hundred fifty percent (150%) of the Projected Proxy Cost for each MSG Configuration of the resources. The Projected Proxy Cost for natural gas-fired resources will include a gas price component, a Variable Start-Up Operations and Maintenance Adder component and a Variable Minimum Load Operations and Maintenance Adder component, if available, a volumetric Grid Management Charge component, and, if eligible, a projected Greenhouse Gas Allowance Price component calculated as set forth in this Section 39.6.1.6. The Projected Proxy Cost for non-natural gas-fired resources will be based on costs provided to the CAISO pursuant to Section 30.4.5.2, a Variable Start-Up Operations and Maintenance Adder component and a Variable Minimum Load Operations and Maintenance Adder component, if available, a volumetric Grid Management Charge component, and, if eligible, a projected Greenhouse Gas Allowance Price component calculated as set forth in this Section 39.6.1.6.

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39.6.1.6.3 Variable Operations and Maintenance Adder Components

The Variable Start-Up Operations and Maintenance Adder component and the Variable Minimum Load Operations and Maintenance Adder component are determined based on the process set forth in Section 30.4.5.4.

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39.7.1.1 Variable Cost Option

For natural gas-fueled units, the Variable Cost Option will calculate the Default Energy Bid by adding incremental cost (comprised of incremental fuel cost plus a volumetric Grid Management Charge adder plus a greenhouse gas cost adder if applicable) with the Variable Energy Operation and Maintenance Adder, by multiplying the sum by the Default Energy Bid Multiplier, adding a Bid Adder if applicable for a Frequently Mitigated Unit, and adding Variable Energy Opportunity Costs, if any. For non-natural gas-fueled units, the Variable Cost Option will calculate the Default Energy Bid by summing incremental fuel or fuel-equivalent cost plus a volumetric Grid Management Charge plus a greenhouse gas cost adder if applicable, multiplying the sum by the Default Energy Bid Multiplier, adding a Bid Adder if applicable for a Frequently Mitigated Unit, and adding Variable Energy Opportunity Costs, if any. For any Default Energy Bids calculated under the Variable Cost Option that exceed $1,000 per MWh because of an approved Reference Level Change Request, any ten percent (10%) adder or Frequently Mitigated Unit adder shall not exceed $100 per MWh.

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39.7.1.1.2 [Not used]

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39.7.1.3.2 Negotiated Values and Informational Filings

39.7.1.3.2.1 Renegotiation of Values

The CAISO may require the renegotiation of any components including any Opportunity Costs negotiated pursuant to Section 30.4.6.3, any Default Energy Bids negotiated pursuant to this Section 39.7.1.3, or any temporary Default Energy Bids established pursuant to Section 39.7.1.5,that have become outdated, are possibly erroneous, or for which the Scheduling Coordinator has changed. In the renegotiation process, the CAISO may review and propose modifications to such values, and may require the Scheduling Coordinator to provide updated information to support continuation of such values.

39.7.1.3.2.2 Informational Filings with FERC

The CAISO shall make an informational filing with FERC of any Opportunity Costs calculated pursuant to Section 30.4.6.2 or negotiated pursuant to Section 30.4.6.3, any Default Energy Bids negotiated pursuant to this Section 39.7.1.3, or any temporary Default Energy Bids established pursuant to Section 39.7.1.5, no later than seven (7) days after the end of the month in which the Opportunity Cost or Default Energy Bid values were established.

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Appendix A

Master Definitions Supplement

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Variable Cost -

The cost associated with fuel cost and Variable Energy Operations and Maintenance Adders.

Variable Cost Option -

A method of calculation Default Energy Bids based on fuel costs and Variable Energy Operations and Maintenance Adders.

Variable Energy Operations and Maintenance Adder -

An adder to Minimum Load Costs and to Default Energy Bids calculated under the Variable Cost Option that is determined pursuant to Section 30.4.5.4.

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Variable Minimum Load Operations and Maintenance Adder -

An adder to Minimum Load Costs that is determined pursuant to Section 30.4.5.4.

Variable Operations and Maintenance Adder -

A Variable Start-Up Operations and Maintenance Adder, Variable Minimum Load Operations and Maintenance Adder, or Variable Energy Operations and Maintenance Adder.

Variable Start-Up Operations and Maintenance Adder -

An adder to Start-Up costs that is determined pursuant to Section 30.4.5.4.

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Attachment B-2

Marked Tariff

Red-line for Variable Operations and Maintenance Tariff Revisions

All the tariff revisions shown below will become effective on January 1, 2022

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11.8.2.1 IFM Bid Cost Calculation

For each Settlement Interval, the CAISO shall calculate IFM Bid Cost for each Bid Cost Recovery Eligible Resource as the algebraic sum of the IFM Start-Up Cost, IFM Transition Cost, IFM Minimum Load Cost, IFM Pump Shut-Down Cost, IFM Energy Bid Cost, IFM Pumping Cost, and IFM AS Bid Cost. For Multi-Stage Generating Resources, in addition to the specific IFM Bid Cost rules described in Section 11.8.2.1, the CAISO will apply the rules described in Section 11.8.1.3 to further determine the applicable MSG Configuration-based CAISO Market Start-Up Bid Cost, Transition Bid Cost, and Minimum Load Bid Cost in any given Settlement Interval. For Multi-Stage Generating Resources, the incremental IFM Start-Up Costs, IFM Minimum Load Costs, and IFM Transition Costs to provide Energy Scheduled in the Day-Ahead Schedule or awarded RUC or Ancillary Service capacity for an MSG Configuration other than the self-scheduled MSG Configuration are determined by the IFM rules specified in Section 31.3. For RMR Resources, the CAISO shall calculate the IFM Bid Cost as the algebraic sum of the IFM Start-Up Cost adjusted to remove Opportunity Costs ~~and Major Maintenance Costs~~, IFM Transition Cost adjusted to remove Opportunity Costs ~~and Major Maintenance Adder Costs~~, IFM Minimum Load Costs adjusted to remove Opportunity Costs ~~and Major Maintenance Adder Costs~~, IFM Energy Bid Cost adjusted to remove Opportunity Costs, and IFM AS Bid Cost. The CAISO will also adjust the IFM Bid Costs for RMR Resources, to remove any bid adder that includes costs that were

recovered under the RMR Contract.

* * * * *

11.8.2.1.2 IFM Minimum Load Cost

The IFM Minimum Load Cost for the applicable Settlement Interval shall be the Minimum Load Bid Cost applicable to the Integrated Forward Market, divided by the number of Settlement Intervals in a Trading Hour subject to the rules described below.

(a) For each Settlement Interval, only the IFM Minimum Load Cost in a CAISO IFM Commitment Period is eligible for Bid Cost Recovery.

(b) The IFM Minimum Load Cost for any Settlement Interval is zero if: (1) the Settlement Interval is in an IFM Self Commitment Period for the Bid Cost Recovery Eligible Resource; or (2) the Bid Cost Recovery Eligible Resource is manually pre-dispatched under a Legacy RMR Contract prior to the Day-Ahead Market or the resource is flagged as an RMR Dispatch in the Day-Ahead Schedule for the applicable Settlement Interval.

(c) If the CAISO commits a Bid Cost Recovery Eligible Resource in the Day-Ahead and the resource receives a Day-Ahead Schedule and the CAISO subsequently de-commits the resource in the Real-Time Market, the IFM Minimum Load Costs are subject to the Real-Time Performance Metric for each case specified in Section 11.8.4.4. If the CAISO commits an RMR Resource in the Day-Ahead and the resource receives a Day-Ahead Schedule and the CAISO subsequently de-commits the resource in the

Real-Time Market, the sum of IFM Minimum Load Costs, adjusted to remove Minimum Load Opportunity Costs and Variable Minimum Load Operations and~~Major~~ Maintenance Adders~~Costs~~, are subject to the Real-Time Performance Metric for each case specified in Section 11.8.4.4.

(d) If a Multi-Stage Generating Resource is committed by the CAISO and receives a Day-Ahead Schedule and subsequently is committed by the CAISO to a lower MSG Configuration where its Minimum Load capacity as registered in the Master File in the Real-Time Market is lower than the CAISO IFM Commitment Period MSG Configuration's Minimum Load as registered in the Master File, the resource's IFM Minimum Load Costs are subject to the Real-Time Performance Metric for each case specified in Section 11.8.4.4. If the CAISO commits an RMR Multi-Stage Generating Resource in the Day-Ahead and the resource receives a Day-Ahead Schedule and the CAISO subsequently de-commits the resource in the Real-Time Market, the sum of IFM Minimum Load Costs, adjusted to remove Minimum Load Opportunity Costs and Variable Minimum Load Operations and~~Major~~ Maintenance Adders~~Costs~~, are subject to the Real-Time Performance Metric for each case specified in Section 11.8.4.4.

(e) If the conditions in Sections 11.8.2.1.2 (c) and (d) do not apply, then the IFM Minimum Load Cost for any Settlement Interval is zero if the Bid Cost Recovery Eligible Resource is determined to be Off during the applicable Settlement Interval. For the purposes of determining IFM Minimum Load Cost, a Bid Cost Recovery Eligible Resource is assumed to be On if its

metered Energy in a Settlement Interval is equal to or greater than the difference between its (i) Minimum Load as registered in the Master File, or if applicable, as modified pursuant to Section 9.3.3, and (ii) the Tolerance Band, and the Metered Energy is greater than zero (0) MWh. Otherwise, such resource is determined to be Off.

(f) For Multi-Stage Generating Resources, the commitment period is determined based on application of section 11.8.1.3. If application of section 11.8.1.3 dictates that the IFM is the Commitment Period, then the calculation of the IFM Minimum Load Costs will depend on whether the IFM committed MSG Configuration is determined to be On. If it is determined to be On, then, the IFM Minimum Load Costs will be based on the Minimum Load Bid Costs of the IFM committed MSG Configuration. For the purposes of determining IFM Minimum Load Cost for a Multi-Stage Generating Resource, a Bid Cost Recovery Eligible Resource is determined to be On if its metered Energy in a Settlement Interval is equal to or greater than the difference between its IFM MSG Configuration Minimum Load as registered in the Master File, or if applicable, as modified pursuant to Section 9.3.3, and the Tolerance Band, and the Metered Energy is greater than zero (0) MWh. Otherwise, such resource is determined to be Off.

(g) The IFM Minimum Load Costs calculation is subject to the Shut-Down State Variable and is disqualified as specified in Section 11.17.2.

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11.8.3.1 RUC Bid Cost Calculation

For each Settlement Interval, the CAISO shall determine the RUC Bid Cost for a Bid Cost Recovery Eligible Resource as the algebraic sum of the RUC Start-Up Cost, RUC Transition Cost, RUC Minimum Load Cost, and RUC Availability Bid Cost. For Multi-Stage Generating Resources, in addition to the specific RUC Bid Cost rules described in Section 11.8.3.1, the rules described in Section 11.8.1.3 will be applied to further determine the applicable MSG Configuration-based CAISO Market Start-Up Bid Costs, Transition Bid Costs, and Minimum Load Bid Costs. For Multi-Stage Generating Resources, the incremental RUC Start-Up Costs, RUC Minimum Load Costs, and RUC Transition Costs to provide RUC awarded capacity for an MSG Configuration other than the self-scheduled MSG Configuration are determined by the RUC optimization rules in specified in Section 31.5. For each Settlement Interval, the CAISO shall determine the RUC Bid Cost for an RMR Resource as the algebraic sum of the RUC Start-Up Cost adjusted to remove Opportunity Costs and Variable Start-Up Operations and~~Major~~ Maintenance Adders~~Costs~~, and RUC Transition Cost adjusted to remove Opportunity Costs and Variable Start-Up Operations and~~Major~~ Maintenance Adders~~Costs~~.

* * * * *

11.8.4.1 RTM Bid Cost Calculation

For each Settlement Interval, the CAISO shall calculate RTM Bid Cost for each Bid Cost

Recovery Eligible Resource, as the algebraic sum of the RTM Start-Up Cost, RTM Minimum Load Cost, RTM Transition Cost, RTM Pump Shut-Down Cost, RTM Energy Bid Cost, RTM Pumping Cost and RTM AS Bid Cost. For each Settlement Interval, the CAISO shall calculate RTM Bid Cost for each RMR Resource as the algebraic sum of the RTM Start-Up Cost adjusted to remove Opportunity Costs and Variable Start-Up Operations and~~Major~~ Maintenance Adders~~Costs~~, RTM Transition Costs adjusted to remove Opportunity Costs and Variable Start-Up Operations and~~Major~~ Maintenance Adders~~Costs~~, RTM Energy Bid Cost adjusted to remove Opportunity Costs and Variable Energy Operations and~~Major~~ Maintenance Adders~~Costs~~, and RTM AS Bid Cost. For Multi-Stage Generating Resources, in addition to the specific RTM Bid Cost rules described in Section 11.8.4.1, the rules described in Section 11.8.1.3 will be applied to further determine the applicable MSG Configuration-based CAISO Market Start-Up Bid Cost, Transition Bid Cost, and Minimum Load Bid Cost, in a given Settlement Interval. For Multi-Stage Generating Resources, the incremental RTM Start-Up Cost, RTM Minimum Load Cost, and RTM Transition Cost to provide RTM committed Energy or awarded Ancillary Services capacity for an MSG Configuration other than the self-scheduled MSG Configuration are determined by the RTM optimization rules in specified in Section 34.

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30.4.5 Proxy Cost Methodology

The CAISO will calculate Proxy Costs as described in this Section 30.4.5.

30.4.5.1 Natural Gas-Fired Resources

For each natural gas-fired resource, the CAISO will calculate a resource's Proxy Costs based on the resource's actual unit-specific performance parameters and applicable gas prices as described below.

(a) **Fuel Input.** The CAISO will calculate Proxy Costs using formulaic natural gas cost values adjusted for fuel-cost variation, based on the natural gas price calculated pursuant to Section 39.7.1.1.1.3, and consistent with the requirements specified below.

(b) **Proxy Start-Up Cost.** Proxy Start-Up Costs will also include:

(i) ~~the cost of auxiliary power calculated using the unit-specific MWh quantity of auxiliary power used for Start-Up multiplied by a resource-specific electricity price;~~a Variable Start-Up Operations and Maintenance Adder as provided in Section 30.4.5.4;

(ii) a greenhouse gas cost adder for each resource located within the CAISO Balancing Authority Area or an EIM Entity Balancing Authority Area within California, and registered with the California Air Resources Board as having a greenhouse gas compliance obligation, which is calculated for each Start-Up as the product of the resource's fuel requirement per Start-Up, the greenhouse gas emissions rate authorized by the California Air Resources Board, and the applicable Greenhouse Gas Allowance Price; ~~and~~

(iii) the rates for the Market Services Charge and System Operations Charge multiplied by the shortest Start-Up Time listed for the resource in the Master File, multiplied by the PMin of the resource as registered in the Master File, multiplied by 0.5; and.

(iv) the cost of auxiliary power calculated using the unit-specific MWh quantity of auxiliary power used for Start-Up multiplied by a resource-specific electricity price.

(c) **Proxy Cost Minimum Load Costs.** Proxy Cost Minimum Load Costs will also include:

(i) a Variable Energy oOperations and mMaintenance Addercosts as provided in Section 30.4.5.439.7.1.1.2;

(ii) a Variable Minimum Load Operations and Maintenance Adder as provided in Section 30.4.5.4.

(iii) a greenhouse gas cost adder for each resource located within the CAISO Balancing Authority Area or an EIM Entity Balancing Authority Area within California, and registered with the California Air Resources Board as having a greenhouse gas compliance obligation, which is calculated for each run-hour as the product of the resource's fuel requirement at Minimum Load as registered in the Master File, the greenhouse gas emissions rate authorized by the California Air Resources Board, and the applicable

Greenhouse Gas Allowance Price;

(~~iii~~iv) the rates for the Market Services Charge and System Operations Charge multiplied by the PMin of the resource as registered in the Master File; and

(~~i~~v) the Bid Segment Fee.~~; and~~

~~(v) a resource-specific adder, if applicable, for major maintenance expenses ($ per operating hour) determined pursuant to Section 30.4.5.4.~~

(d) **Proxy Transition Costs.** For each Multi-Stage Generating Resource under the Proxy Cost methodology, the CAISO will calculate the Proxy Transition Costs utilized for each feasible transition from a given MSG Configuration to a higher MSG Configuration based on the difference between the Proxy Start-Up Costs for the higher MSG Configuration, and the Proxy Start-Up Costs for the lower MSG Configuration, as those costs are determined in accordance with the Proxy Start-Up Cost calculation methodology set forth in Section 30.4.5. If the result of this calculation is negative for any transition between two MSG Configurations, then the associated Proxy Transition Cost shall be zero.

~~(e) **Major Maintenance Adders.** Proxy Costs will include any major maintenance adders determined pursuant to Section 30.4.5.4.~~

30.4.5.2 Non-Natural Gas-Fired Resources

For each non-natural gas-fired resource, the CAISO shall calculate the Proxy Start-Up Cost and Proxy Minimum Load Cost values under the Proxy Cost methodology as specified below.

(a) **Fuel Input.** The Scheduling Coordinator for the resource will provide the fuel or fuel-equivalent input costs, which the CAISO will maintain in the Master File, pursuant to Section 39.7.1.1.1.2.

(b) **Proxy Start-Up Costs.** Proxy Start-Up Costs will also include, if applicable:

(i) a Variable Start-Up Operations and Maintenance Adder as provided in Section 30.4.5.4;

(ii) greenhouse gas allowance costs for each resource located within the CAISO Balancing Authority Area or an EIM Entity Balancing Authority Area within California, and registered with the California Air Resources Board as having a greenhouse gas compliance obligation, as provided to the CAISO by the Scheduling Coordinator;

(iii) the rates for the Market Services Charge and System Operations Charge multiplied by the shortest Start-Up Time listed for the resource in the Master File, multiplied by the PMin of the resource as registered in the Master File, multiplied by 0.5.

(c) **Proxy Minimum Load Costs.** Proxy Minimum Load Costs will also include, if applicable:

(i) a Variable Energy Ooperation and mMaintenance Addercosts as provided in Section 30.4.5.439.7.1.1.2 multiplied by the PMin of the resource or MSG Configuration of the resource as registered in the Master File;

(ii) a Variable Minimum Load Operations and Maintenance Adder as provided in Section 30.4.5.4;

(iii) greenhouse gas allowance costs for each resource located within the CAISO Balancing Authority Area or an EIM Entity Balancing Authority Area within California, and registered with the California Air Resources Board as having a greenhouse gas compliance obligation, as provided to the CAISO by the Scheduling Coordinator;

(iiiiv) the rates for the Market Services Charge and System Operations Charge multiplied by the PMin of the resource as registered in the Master File; and

(iv) the Bid Segment Fee.

(d) **Proxy Transition Costs.** For each Multi-Stage Generating Resource under the Proxy Cost methodology, the CAISO will calculate the Proxy Transition Costs utilized for each feasible transition from a given MSG Configuration to a higher MSG Configuration based on the difference between the Proxy Start-Up Costs for the higher MSG Configuration, and the Proxy Start-Up Costs for the lower MSG Configuration, as those costs are determined in accordance with the Proxy Start-Up Cost calculation

methodology set forth in Section 30.4.5. If the result of this calculation is negative for any transition between two MSG Configurations, then the associated Proxy Transition Cost shall be zero.

~~(e) **Major Maintenance Adders.** Proxy Costs will include any major maintenance adders determined pursuant to Section 30.4.5.4.~~

30.4.5.3 Multi-Stage Generating Resources

30.4.5.3.1 Application of Proxy Costs

For Multi-Stage Generating Resources under the Proxy Cost methodology, the CAISO will apply the Proxy Cost methodology to all the MSG Configurations. The Proxy Costs for Multi-Stage Generating Resources will be calculated for each specific MSG Configuration, including for each MSG Configuration that cannot be directly started.

30.4.5.3.2 Insufficient Information

Notwithstanding the rules set forth in Sections 30.4.5.1 and 30.4.5.2, to the extent that a Scheduling Coordinator for a Multi-Stage Generating Resource, other than in its lowest configuration in which the Multi-Stage Generating Resource can be started, does not provide sufficient data for the CAISO to determine a component of the Proxy Start-Up Costs or Proxy Minimum Load Costs for a particular MSG Configuration, the CAISO will, if feasible, use the value for that component associated with the next-lowest MSG Configuration.

30.4.5.4 Variable Operations and~~Adders for Major~~ Maintenance Adders~~Expenses~~

30.4.5.4.1 Generally

Each resource that satisfies the applicable fuel source and technology requirements set forth in Section 30.4.5.4.2 will receive the default Variable Operations and Maintenance

Adders specified thereunder. The Scheduling Coordinator for any resource may choose to negotiate with the CAISO pursuant to Section 30.4.5.4.3 for negotiated Variable Operations and Maintenance Adders that supersede or replace any default Variable Operations and Maintenance Adders the resource may receive. Variable Operations and Maintenance Adders are subject to renegotiation pursuant to Section 30.4.5.4.4 and to informational filings pursuant to Section 30.4.5.4.5. Pursuant to Section 30.4.5.4.6, the CAISO will convert negotiated operations and maintenance values that were established for a resource prior to January 1, 2022 into corresponding negotiated Variable Operations and Maintenance Adders.

~~Scheduling Coordinators may propose adders for major maintenance expenses as a component of Proxy Start-Up Costs, Proxy Minimum Load Costs, or both. Such proposed adders must be based solely on resource-specific information derived from actual maintenance costs, when available, or estimated maintenance costs provided by the Scheduling Coordinators to the CAISO and the Independent Entity.~~

30.4.5.4.2 Default Variable Operations and Maintenance Adders

The default Variable Start-Up Operations and Maintenance Adder for a frame combustion turbine resource will equal $52.13 per start per MW multiplied by the PMax of the resource or MSG Configuration of the resource.

The default Variable Minimum Load Operations and Maintenance Adder will vary by fuel source or technology as follows: (1) for a natural gas-fired combined cycle resource, the adder will equal $1.74 per run-hour per MW multipled by the PMax of the resource or MSG Configuration of the resource; (2) for an aeroderivative combustion turbine resource, the adder will equal $4.38 per run-hour per MW multiplied by the PMax of the

resource or MSG Configuration of the resource; and (3) for a hydroelectric resource, the adder will equal $0.65 per run-hour per MW multiplied by the PMax of the resource or MSG Configuration of the resource.

The default Variable Energy Operations and Maintenance Adder will vary by fuel source or technology as follows: (1) nuclear $1.08/MWh; (2) coal $2.69/MWh; (3) wind $0.28/MWh; (4) natural gas-fired combined cycle units $0.59/MWh; (5) steam units $0.33/MWh; (6) geothermal $1.16/MWh; (7) landfill gas $1.21/MWh; (8) frame combustion turbines $0.97/MWh; (9) aeroderivative combustion turbines $2.15/MWh; (10) reciprocating internal combustion engines $1.10/MWh; and (11) biomass $1.65/MWh.

Effective January 1, 2022, default adders established pursuant to this Section 30.4.5.4.2 will supersede and replace any then-existing default adders established prior to that effective date.

30.4.5.4.3 Negotiated Variable Operations and Maintenance Adders

30.4.5.4.3.1 Principles

The CAISO will negotiate resource-specific and MSG Configuration-specific Variable Operations and Maintenance Adders with a Scheduling Coordinator based on the following principles:

(a) Any operations costs proposed for inclusion in the Variable Operations and Maintenance Adders must be variable operations costs, meaning the costs of consumables and other costs that vary directly with electrical production (*i.e.*, Start-Up/Shut-Down, run-hours, or electricity output) of a

resource. Variable operations costs exclude maintenance costs, auxiliary power costs, Greenhouse Gas Allowance Prices, fuel costs, grid management charges, Opportunity Costs, and other excluded costs set forth in the Business Practice Manual.

(b) Any maintenance costs proposed for inclusion in the Variable Operations and Maintenance Adders must be variable maintenance costs, meaning the costs associated with the repair, overhaul, replacement, or inspection of a resource that meet the following conditions:

(i) The costs must vary with the electrical production (*i.e.*, Start-Up/Shut-Down, run-hours, or electricity output) of the resource.

(ii) The costs should reflect future maintenance costs that are expected to be incurred within the service life of a major component of plant or equipment.

(iii) The costs should be consistent with Good Utility Practice.

(iv) The costs should not effect a substantial betterment of the resource.

(v) If the item is a replacement, it cannot be a replacement of an existing major component of plant or equipment.

30.4.5.4.3.2 CAISO Processes

Scheduling Coordinators may submit updated resource-specific ~~major maintenance~~ and MSG Configuration-specific information for purposes of seeking a change to any negotiated Variable Operations and~~major~~ ~~m~~Maintenance ~~a~~Adder, no sooner than thirty (30) days after a negotiated Variable Operations and~~major~~ ~~m~~Maintenance ~~a~~Adder has

been determined. The CAISO will evaluate the information provided by Scheduling Coordinators, and may require Scheduling Coordinators to provide additional information, to enable the CAISO to determine reasonable negotiated Variable Operations and Maintenance ~~a~~Adders ~~for major maintenance expenses~~ or to conduct audits of negotiated Variable Operations and~~major m~~Maintenance Adders~~expenses~~. The CAISO will notify the Scheduling Coordinator in writing whether it has sufficient and accurate information to determine reasonable negotiated Variable Operations and~~major m~~Maintenance ~~a~~Adders to be included in the calculations for the Proxy Start-Up Cost, ~~or~~ Proxy Minimum Load Cost, and/or Default Energy Bid under the Variable Cost Option ~~calculations, or both~~. Within ten (10) days after providing written notification to the Scheduling Coordinator that the information is sufficient and accurate, the CAISO will determine the reasonable negotiated Variable Operations and Maintenance ~~a~~Adders ~~for major maintenance expenses~~ to be included in the Proxy Start-Up Costs, ~~or~~ Proxy Minimum Load Costs, and/or Default Energy Bids under the Variable Cost Option~~or both~~, and will so inform the Scheduling Coordinator in writing.

In the event of a dispute regarding the sufficiency or accuracy of the information provided by the Scheduling Coordinator, the CAISO and the Scheduling Coordinator will enter a period of good-faith negotiations that terminates sixty (60) days after the date the dispute began. If the CAISO and the Scheduling Coordinator resolve the dispute during the 60-day negotiation period, within ten (10) days of such agreement, the CAISO will determine the reasonable negotiated Variable Operations and Maintenance ~~a~~Adders ~~for major maintenance expenses~~ and will provide the adders to the Scheduling Coordinator in writing. If the CAISO and the Scheduling Coordinator fail to agree upon

the sufficiency or accuracy of the information during the 60-day negotiation period, the Scheduling Coordinator has the right to petition FERC to resolve the dispute as to the sufficiency or accuracy of its information.

In the event of a dispute regarding the CAISO's determination of Variable Operations and Maintenance ~~a~~Adders ~~for major maintenance expenses~~, the CAISO and the Scheduling Coordinator will enter a period of good-faith negotiations that terminates sixty (60) days after the date the dispute began. If the CAISO and the Scheduling Coordinator resolve the dispute during the 60-day negotiation period, the agreed-upon negotiated Variable Operations and Maintenance Adders~~values~~ will be effective as of the first Business Day following the resolution date.

30.4.5.4.3.3 FERC Processes

If the CAISO and the Scheduling Coordinator fail to agree on the Variable Operations and~~major m~~Maintenance Adders~~values~~ for ~~either~~ the Proxy Start-Up Costs, ~~or~~ Proxy Minimum Load Costs, and/or Default Energy Bids under the Variable Cost Option following the 60-day negotiation period, the Scheduling Coordinator has the right to file proposed values and supporting information for the~~major maintenance~~ adders ~~for the Proxy Start-Up Costs or Proxy Minimum Load Costs~~ with FERC pursuant to Section 205 of the Federal Power Act.

30.4.5.4.3.4 Interim Variable Operations and Maintenance Adders Pending Dispute Resolution

In the event of a dispute regarding the reasonableness of the Variable Operations and Maintenance ~~a~~Adders ~~for major maintenance expenses~~ determined by the CAISO, but not a dispute regarding the sufficiency or accuracy of the information provided by the Scheduling Coordinator, the CAISO will determine ~~a~~ reasonable interim Variable

Operations and Maintenance ~~a~~Adders ~~for major maintenance expenses~~ until the adders ~~for major maintenance expenses~~ are~~is~~ determined by agreement between the CAISO and the Scheduling Coordinator or by FERC. Any subsequent agreement or FERC order determining the Variable Operations and Maintenance ~~a~~Adders ~~for major maintenance expenses~~ will be reflected in an adjustment to the interim Variable Operations and Maintenance ~~a~~Adders ~~for major maintenance expenses~~ in the next applicable Settlement Statement.

30.4.5.4.4 Renegotiation of Variable Operations and Maintenance Adders

The CAISO may require the renegotiation of any negotiated or interim Variable Operations and Maintenance Adders established pursuant to Section 30.4.5.4.3 that have become outdated, are possibly erroneous, or for which the Scheduling Coordinator has changed. In the renegotiation process, the CAISO may review and propose modifications to such Variable Operations and Maintenance Adders, and may require the Scheduling Coordinator to provide updated information to support their continuation.

30.4.5.4.5 Informational Filings

The CAISO shall make an informational filing with FERC of any default Variable Operations and Maintenance Adders established pursuant to Section 30.4.5.4.2 and any negotiated or interim Variable Operations and Maintenance Adders established pursuant to Section 30.4.5.4.3, no later than seven (7) days after the end of the month for which the Variable Operations and Maintenance Adders were established.

30.4.5.4.6 Conversion of Existing Negotiated Values

Notwithstanding any other provision in this Section 30.4.5.4, effective January 1, 2022, the CAISO will convert any then-existing adder values for major maintenance expenses

previously established for a resource pursuant to Section 30.4.5.4 (or any predecessor of that Section), and will convert any then-existing negotiated operations and maintenance values previously established for a resource pursuant to Section 39.7.1.1.2 (or any predecessor of that Section), into corresponding negotiated Variable Operations and Maintenance Adders with values equivalent to the previously established values. Each Scheduling Coordinator for a resource for which the CAISO performs such conversions will subsequently have the option to either: (1) retain the corresponding Variable Operations and Maintenance Adders for the resource; (2) negotiate changes to all of the corresponding Variable Operations and Maintenance Adders for the resource pursuant to Section 30.4.5.4.3; or (3) negotiate changes to some of the corresponding Variable Operations and Maintenance Adders for the resource pursuant to Section 30.4.5.4.3, and have the CAISO convert the balance of the corresponding Variable Operations and Maintenance Adders into default Variable Operations and Maintenance Adders pursuant to Section 30.4.5.4.2.

* * * * *

39.6.1.6 Maximum Start-Up Cost and Minimum Load Cost Registered Cost Values

The maximum Start-Up Cost and Minimum Load Cost values registered in the Master File by Scheduling Coordinators for capacity of non-Multi-Stage Generating Resources that are eligible and elect to use the Registered Cost methodology in accordance with Section 30.4 cannot exceed the Minimum Load Cost Hard Cap and will be limited to one hundred fifty percent (150%) of the Projected Proxy Cost. The maximum Start-Up Cost

and Minimum Load Cost values registered in the Master File by Scheduling Coordinators for capacity of Multi-Stage Generating Resources that are eligible and elect to use the Registered Cost methodology in accordance with Section 30.4 will be limited to one hundred fifty percent (150%) of the Projected Proxy Cost for each MSG Configuration of the resources. The Projected Proxy Cost for natural gas-fired resources will include a gas price component, a Variable Start-Up Operations and~~major m~~Maintenance Adder component and a Variable Minimum Load Operations and Maintenance Adder~~expense~~ component, if available, a volumetric Grid Management Charge component, and, if eligible, a projected Greenhouse Gas Allowance Price component calculated as set forth in this Section 39.6.1.6. The Projected Proxy Cost for non-natural gas-fired resources will be based on costs provided to the CAISO pursuant to Section 30.4.5.2, a Variable Start-Up Operations and~~major m~~Maintenance Adder~~expense~~ component and a Variable Minimum Load Operations and Maintenance Adder component, if available, a volumetric Grid Management Charge component, and, if eligible, a projected Greenhouse Gas Allowance Price component calculated as set forth in this Section 39.6.1.6.

* * * * *

39.6.1.6.3 Variable Operations and~~Major~~ Maintenance Adder~~Expense~~ Component~~s~~

The Variable Start-Up Operations and~~major m~~Maintenance Adder~~expense~~ component and the Variable Minimum Load Operations and Maintenance Adder component are~~is~~ determined based on the process set forth in Section 30.4.5.4.

* * * * *

39.7.1.1 Variable Cost Option

For natural gas-fueled units, the Variable Cost Option will calculate the Default Energy Bid by adding incremental cost (comprised of incremental fuel cost plus a volumetric Grid Management Charge adder plus a greenhouse gas cost adder if applicable) with the ~~v~~Variable Energy ~~o~~Operation and ~~m~~Maintenance Adder~~cost~~, by multiplying the sum by the Default Energy Bid Multiplier, adding a Bid Adder if applicable for a Frequently Mitigated Unit, and adding Variable Energy Opportunity Costs, if any. For non-natural gas-fueled units, the Variable Cost Option will calculate the Default Energy Bid by summing incremental fuel or fuel-equivalent cost plus a volumetric Grid Management Charge plus a greenhouse gas cost adder if applicable, multiplying the sum by the Default Energy Bid Multiplier, adding a Bid Adder if applicable for a Frequently Mitigated Unit, and adding Variable Energy Opportunity Costs, if any. For any Default Energy Bids calculated under the Variable Cost Option that exceed $1,000 per MWh because of an approved Reference Level Change Request, any ten percent (10%) adder or Frequently Mitigated Unit adder shall not exceed $100 per MWh.

* * * * *

39.7.1.1.2 [Not used]~~Variable Operation and Maintenance Cost Under the Variable Cost Option~~

~~The default value for the variable operation and maintenance cost portion will vary by~~

~~fuel source or technology as follows: (1) solar $0.00/MWh; (2) nuclear $1.00/MWh; (3) coal $2.00/MWh; (4) wind $2.00/MWh; (5) hydro $2.50/MWh; (6) natural gas-fired combined cycle and steam units $2.80/MWh; (7) geothermal $3.00 WMh; (8) landfill gas $4.00/MWh; (9) combustion turbines and reciprocating engines $4.80/MWh; and (10) biomass $5.00/MWh. Resource specific values may be negotiated with the CAISO. Default operation and maintenance values as well as any negotiated values will also be used to calculate Default Minimum Load Bids pursuant to Section 30.4.~~

* * * * *

39.7.1.3.2 Negotiated Values and Informational Filings

39.7.1.3.2.1 Renegotiation of Values

The CAISO may require the renegotiation of any components including ~~adders or interim adders for major maintenance expenses determined pursuant to Sections 30.4.5.1, 30.4.5.2, and 30.4.5.4,~~ any Opportunity Costs negotiated pursuant to Section 30.4.6.3, any Default Energy Bids negotiated pursuant to this Section 39.7.1.3, or any temporary Default Energy Bids established pursuant to Section 39.7.1.5, ~~or any custom operation and maintenance adders negotiated pursuant to Section 39.7.1.1.2,~~ that have become outdated, are possibly erroneous, or for which the Scheduling Coordinator has changed. In the renegotiation process, the CAISO may review and propose modifications to such values, and may require the Scheduling Coordinator to provide updated information to support continuation of such values.

39.7.1.3.2.2 Informational Filings with FERC

The CAISO shall make an informational filing with FERC of ~~any adders or interim adders for major maintenance expenses determined pursuant to Sections 30.4.5.1, 30.4.5.2, and 30.4.5.4,~~ any Opportunity Costs calculated pursuant to Section 30.4.6.2 or negotiated pursuant to Section 30.4.6.3, any Default Energy Bids negotiated pursuant to this Section 39.7.1.3, or any temporary Default Energy Bids established pursuant to Section 39.7.1.5, ~~or any custom operations and maintenance adders negotiated pursuant to Section 39.7.1.1.2,~~ no later than seven (7) days after the end of the month in which the Opportunity Cost or Default Energy Bid ~~or operations and maintenance~~ values were established.

* * * * *

Appendix A

Master Definitions Supplement

* * * * *

Variable Cost -

The cost associated with fuel cost and ~~v~~Variable Energy ~~o~~Operations and ~~m~~Maintenance Adders~~costs~~.

Variable Cost Option -

A method of calculation Default Energy Bids based on fuel costs and ~~v~~Variable Energy ~~o~~Operations and ~~m~~Maintenance Adders~~costs~~.

Variable Energy Operations and Maintenance Adder -

An adder to Minimum Load Costs and to Default Energy Bids calculated under the Variable Cost Option that is determined pursuant to Section 30.4.5.4.

* * * * *

Variable Minimum Load Operations and Maintenance Adder -

An adder to Minimum Load Costs that is determined pursuant to Section 30.4.5.4.

Variable Operations and Maintenance Adder -

A Variable Start-Up Operations and Maintenance Adder, Variable Minimum Load Operations and Maintenance Adder, or Variable Energy Operations and Maintenance Adder.

Variable Start-Up Operations and Maintenance Adder -

An adder to Start-Up costs that is determined pursuant to Section 30.4.5.4.

* * * * *

Attachment C-1

Clean Tariff

Variable Operations and Maintenance Tariff Revisions

All the tariff language shown below will be effective on April 1, 2022

30.4.5.4.3.2 CAISO Processes

Scheduling Coordinators may submit updated resource-specific and MSG Configuration-specific information for purposes of seeking a change to any negotiated Variable Operations and Maintenance Adder, no sooner than thirty (30) Business Days after a negotiated Variable Operations and Maintenance Adder has been determined. The CAISO will evaluate the information provided by Scheduling Coordinators, and may require Scheduling Coordinators to provide additional information, to enable the CAISO to determine reasonable negotiated Variable Operations and Maintenance Adders or to conduct audits of negotiated Variable Operations and Maintenance Adders. Within fifteen (15) Business Days of receipt of the information or any requested additional information, the CAISO will notify the Scheduling Coordinator in writing whether it has sufficient and accurate information to determine reasonable negotiated Variable Operations and Maintenance adders to be included in the calculations for the Proxy Start-Up Cost, Proxy Minimum Load Cost, and/or Default Energy Bid under the Variable Cost Option. Within ten (10) Business Days after providing written notification to the Scheduling Coordinator that the information is sufficient and accurate, the CAISO will determine the reasonable negotiated Variable Operations and Maintenance Adders to be included in the Proxy Start-Up Costs, Proxy Minimum Load Costs, and/or Default Energy Bids under the Variable Cost Option, and will so inform the Scheduling Coordinator in writing.

In the event of a dispute regarding the sufficiency or accuracy of the information provided by the Scheduling Coordinator, the CAISO and the Scheduling Coordinator will enter a period of good faith negotiations that terminates sixty (60) days after the date

the dispute began. If the CAISO and the Scheduling Coordinator resolve the dispute during the 60-day negotiation period, within ten (10) Business Days of such agreement, the CAISO will determine the reasonable negotiated Variable Operations and Maintenance Adders and will provide the adder to the Scheduling Coordinator in writing. If the CAISO and the Scheduling Coordinator fail to agree upon the sufficiency or accuracy of the information during the 60-day negotiation period, the Scheduling Coordinator has the right to petition FERC to resolve the dispute as to the sufficiency or accuracy of its information.

In the event of a dispute regarding the CAISO's determination of Variable Operations and Maintenance Adders, the CAISO and the Scheduling Coordinator will enter a period of good faith negotiations that terminates sixty (60) days after the date the dispute began. If the CAISO and the Scheduling Coordinator resolve the dispute during the 60-day negotiation period, the agreed-upon negotiated Variable Operations and Maintenance Adders will be effective as of the third Business Day following the resolution date.

Attachment C-2

Marked Tariff

Red-line for Variable Operations and Maintenance Tariff Revisions

All the tariff revisions shown below will become effective on April 1, 2022

30.4.5.4.3.2 CAISO Processes

Scheduling Coordinators may submit updated resource-specific and MSG Configuration-specific information for purposes of seeking a change to any negotiated Variable Operations and Maintenance Adder, no sooner than thirty (30) Business ~~d~~Days after a negotiated Variable Operations and Maintenance Adder has been determined. The CAISO will evaluate the information provided by Scheduling Coordinators, and may require Scheduling Coordinators to provide additional information, to enable the CAISO to determine reasonable negotiated Variable Operations and Maintenance Adders or to conduct audits of negotiated Variable Operations and Maintenance Adders. Within fifteen (15) Business Days of receipt of the information or any requested additional information, ~~T~~the CAISO will notify the Scheduling Coordinator in writing whether it has sufficient and accurate information to determine reasonable negotiated Variable Operations and Maintenance adders to be included in the calculations for the Proxy Start-Up Cost, Proxy Minimum Load Cost, and/or Default Energy Bid under the Variable Cost Option. Within ten (10) Business ~~d~~Days after providing written notification to the Scheduling Coordinator that the information is sufficient and accurate, the CAISO will determine the reasonable negotiated Variable Operations and Maintenance Adders to be included in the Proxy Start-Up Costs, Proxy Minimum Load Costs, and/or Default Energy Bids under the Variable Cost Option, and will so inform the Scheduling Coordinator in writing.

In the event of a dispute regarding the sufficiency or accuracy of the information provided by the Scheduling Coordinator, the CAISO and the Scheduling Coordinator will enter a period of good faith negotiations that terminates sixty (60) days after the date

the dispute began. If the CAISO and the Scheduling Coordinator resolve the dispute during the 60-day negotiation period, within ten (10) Business ~~d~~Days of such agreement, the CAISO will determine the reasonable negotiated Variable Operations and Maintenance Adders and will provide the adder to the Scheduling Coordinator in writing. If the CAISO and the Scheduling Coordinator fail to agree upon the sufficiency or accuracy of the information during the 60-day negotiation period, the Scheduling Coordinator has the right to petition FERC to resolve the dispute as to the sufficiency or accuracy of its information.

In the event of a dispute regarding the CAISO's determination of Variable Operations and Maintenance Adders, the CAISO and the Scheduling Coordinator will enter a period of good faith negotiations that terminates sixty (60) days after the date the dispute began. If the CAISO and the Scheduling Coordinator resolve the dispute during the 60-day negotiation period, the agreed-upon negotiated Variable Operations and Maintenance Adders will be effective as of the third~~first~~ Business Day following the resolution date.

Attachment D

Final Proposal

Tariff Amendment to Implement Variable Operations and Maintenance Cost Initiative

California Independent System Operator Corporation

March 3, 2021

Variable Operations and Maintenance Cost Review

Final Proposal

October 22, 2020

California Independent System Operator

Acronyms

APS – Arizona Public Service

CAISO – California Independent System Operator

CCGT – Combined cycle gas turbine

CT – Combustion turbine

DMM – CAISO Department of Market Monitoring

EIM – the CAISO's Western Energy Imbalance Market

FERC – Federal Energy Regulatory Commission

LTSA – Long-term service agreement

MMA – Major maintenance adder

MSG – Multi-stage generator

MW – Megawatt

MWh – Megawatt-hour

NYISO – New York Independent System Operator

NYSERDA - New York State Energy Research and Development Authority

O&M – Operations and maintenance

PGE – Portland General Electric

PG&E – Pacific Gas & Electric

PPA – Power purchase agreement

PSE – Puget Sound Energy

RDT – Resource data template

VM – Variable maintenance

VO – Variable operations

VOM adder – Variable operations and maintenance adder

USofA – FERC uniform system of accounts

WECC – Western Electricity Coordinating Council

Table of Contents

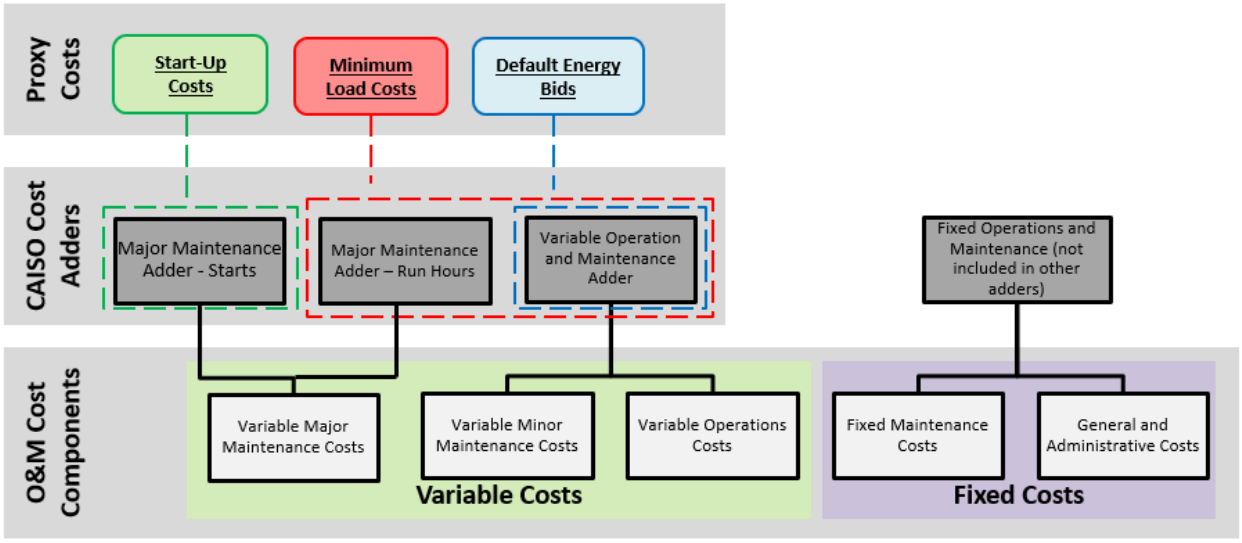
I. Executive Summary

This initiative proposes to change the structure of how operations and maintenance (O&M) costs are accounted for in the CAISO markets. It proposes principles for the categorization of O&M costs and updates how the "adders" that the CAISO markets use to reflect O&M costs are calculated.

Several issues that currently face the CAISO and market participants in the area of O&M costs prompted the need for this initiative. These issues originate from the lack of explicit, publically available principles for the categorization of O&M cost components. Without a shared understanding of these principles, negotiations between the CAISO and market participants can become overly complex and burdensome. In particular, CAISO and market participants must negotiate two adders that reflect O&M costs in the CAISO markets: the variable operations and maintenance (VOM) adder and the major maintenance adder (MMA). In addition to these recurring negotiations, the CAISO also revisits the default VOM adder values triennially. The triennial review has become challenging because there are no reference categories against which the CAISO can compare the existing default values. This initiative addresses these issues by proposing principles for use in the categorization of O&M cost components while also creating a cost framework that gives market participants more flexibility in bidding O&M costs into the CAISO markets and that provides more clarity and consistency in negotiating these adders.

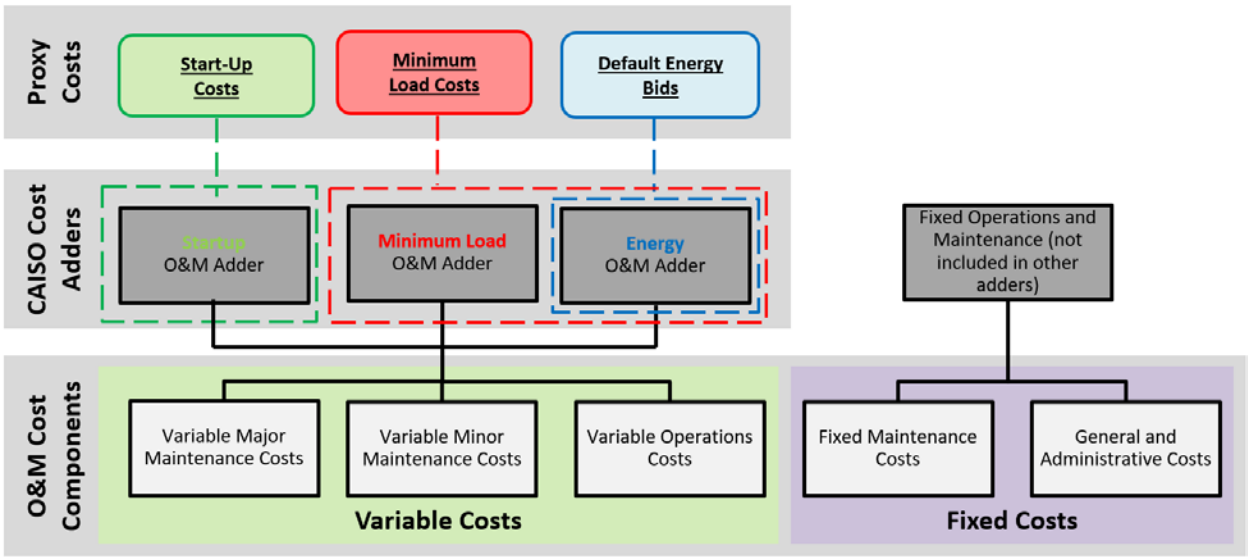
The current O&M cost framework is shown in Figure 1 below. The VOM and MMA adders that are currently in place allow market participants to include their O&M costs in their bids. The CAISO includes these adders in the resource's "proxy costs" that mirror the three parts of market participants' bids into the energy market: default energy bids, minimum load costs, and startup costs. The proxy costs are used in either the caps applied for costs market participants can bid in for minimum load costs and startup costs or the default energy bids for local market power mitigation. The VOM adder is included in default energy bids under the variable cost-based methodology and in minimum load costs under the Proxy Cost option. MMAs are included in minimum load costs and startup costs under the Proxy Cost option.

Figure 1 – Current Cost Recovery Framework in CAISO Markets



This proposal includes two components: 1) explicit proposal of the principles used to categorize O&M cost components to differentiate between fixed and variable O&M costs, 2) O&M Adders that replace the VOM adder and MMA; these adders can be included in any of the three Proxy Costs. The objective of each component of this proposal is to ensure market participants' bids can reflect these costs more accurately. The second component also proposes default values for the O&M Adders that can automatically apply to resources based on technology type so that market participants can avoid negotiating resource-specific values if the defaults are an adequate reflection of their costs. Market participants will still have the ability to negotiate O&M Adders with the CAISO, similar to how they can negotiate VOM adders and MMAs today. Figure 2 shows CAISO's proposal for the updated cost structure.

Figure 2 – Proposed Cost Recovery Framework in CAISO Markets



Section II will discuss more background and provide context as to why the CAISO is conducting this initiative. Section III will discuss the stakeholder comments received by the CAISO on the revised straw proposal and the changes that were made in reaction to those comments. Section IV will lay out the proposed principles, cost recovery framework, and default O&M Adder values; supporting discussion and details accompanying this section can be found in the Appendices. Section V discusses the role of the EIM Governing Body in relation to this initiative. Section VI will discuss the remaining timeline of stakeholder involvement for this initiative.

II. Background

The CAISO initially established the VOM adder values as part of a stakeholder initiative in 2012. To establish the adder values, the CAISO engaged an external consultant, Utilicast LLC., to analyze cost estimates from a variety of external sources and propose estimates on a generation technology-specific level. These are the cost estimates that the CAISO currently uses as default adders in the CAISO markets, *i.e.* generation technologies receive a pre-determined $/MWh VOM value to be included in their default energy bids (DEBs) and minimum load costs. If market participants find that the default values are inadequate, they are able to negotiate VOM adder values with the CAISO.

Around this time, the CAISO introduced MMAs as part of the Commitment Cost Refinements 2012 stakeholder initiative. Potomac Economics, Ltd. was engaged to propose a framework for how major maintenance costs could be recovered in the CAISO markets. Major maintenance costs, such as costs incurred for major equipment overhauls, are incurred in large dollar-value increments at potentially irregular intervals. However, these costs are a direct result of the operation of a generating resource to produce electricity and are thus marginal costs recoverable in the CAISO energy markets. These costs were expected to be incurred based on the number of hours a generating resource is online and/or how many times a generating resource starts up in a given time period.

As described in the final proposal for the Commitment Cost Refinements 2012, CAISO and Potomac Economics, Ltd. planned on creating default MMAs. Stakeholders were generally supportive of the concept of default MMAs but were concerned about the data requirements and difficulty of calculating values that would apply to all resources within a technology group. Based on this feedback, the CAISO determined that market participants should instead negotiate resource-specific MMAs and, thus, the default MMA value were effectively set to zero.

In 2012, the CAISO committed to review the VOM adder values once every three years. The CAISO performed an internal review of the adder values in 2015 and did not change the adder values. In 2018, the CAISO engaged Nexant to conduct a more extensive review of the VOM adder values, resulting in a report being published in December 2018. The CAISO also held five working groups with stakeholders in July 2019 to discuss the Nexant report and O&M costs more broadly.

Through those working groups, the CAISO and stakeholders identified several issues with the current O&M cost framework. In particular, stakeholders noted that the CAISO did not have an explicit set of principles for what variable O&M costs are. For market participants, this leads to challenges in applying for MMAs and negotiated VOM adders. For the CAISO, this leads to difficulty in processing applications in a consistent and efficient manner and in quantifying the cost components in pursuit of updating the default VOM adder values. The current initiative was established to formally address the issues identified in these working groups.

III. Stakeholder comments and changes from draft final proposal

The CAISO appreciates the many helpful comments submitted by stakeholders related to the draft final proposal. In response to these comments, the CAISO has made a number of minor modifications to the proposal. The largest changes that the CAISO has made in this final proposal were made to the Appendices and a brief summary of those changes is presented here.

Alliance Energy Marketing expressed their concern about the inclusion of language in the principle for Variable Maintenance costs about costs “expected to be incurred within the service life of the resource”. The CAISO understands these concerns and acknowledges that the decision to retire a resource involves significant uncertainties into which we will not have transparency. In such cases, the CAISO clarifies that we will request supporting documentation for the scheduling coordinator’s claim that they will perform the maintenance included in their application prior to the end of resource’s service life. Because of the uncertainty around retirement decisions, the CAISO will not assess *how well* the documentation supports the SC’s claim but rather only *whether or not* it supports the SC’s claim. Appendix A contains the edits made to the proposal based on these comments.

PG&E noted in their comments that they were concerned about the timing of implementation of this initiative and how applications for resources with PPAs will be conducted. The CAISO is not committing to a timeline of implementation in this policy proposal and the timeline included in Appendix D is meant to help illustrate the proposed phased approach of negotiations. We believe that PG&E's concerns are valid and, if the proposal is accepted, will be addressed during the planning of the implementation process. Regarding the concerns about negotiations of PPA-based applications where detailed cost information cannot be provided, the CAISO recommends that the resource uses the default O&M adder values proposed herein. The need to review appropriate resource-specific maintenance cost documentation arises because the CAISO has a responsibility under our Tariff to ensure the sufficiency and accuracy of the information provided by the SC. One of the factors driving the CAISO to propose default values reflecting Variable Maintenance costs is to handle situations such as this.

In their comments, APS questioned whether there are plans for a mechanism for automatic annual cost escalation. The CAISO does not currently have plans to automatically apply adjustment factors but will consider whether cost adjustments are warranted when we perform our triennial review. Cost adjustments for factors such as inflation can also be handled via resource-specific negotiations and are often simple and brief.

PSE also provided extensive and thoughtful feedback to the draft final proposal. The CAISO has made adjustments in response to some of these points but not to others. Regarding the belief that non-betterment replacements of major components should be considered Variable Maintenance costs, the CAISO disagrees. We assert that the replacement of a major component such as an entire turbine is not maintaining the resource but rather creating a new resource. Regarding requests for default values for more granular technology groups (e.g. small vs large hydro, B- vs E- vs EA- vs F-class CTs), the CAISO does not have a sufficient number of MMAs against which to cross-validate external estimates to ensure their reasonableness and thus cannot propose default values. As the CAISO performs more negotiations and gathers resource-specific information, we would be willing to revisit these estimates.

IV. Proposal

This final proposal has two main parts: 1) proposing the principles to be used in the categorization of the O&M cost components for inclusion in the CAISO Tariff, and 2) proposing an updated O&M cost framework and the default values for the O&M Adders that comprise this cost framework.

Principles

The CAISO includes the proposed O&M cost categorization principles[1] in this section and provides interpretive guidance to the principles in Appendix A below[2].

The O&M Adder is included in the default energy bid under the Variable Cost option and the Minimum Load Bid Cap and Startup Bid Cap under the Proxy Cost option. The O&M Adder reflects Variable Operations and Variable Maintenance costs that vary directly with the electricity output, run-hours, or start-up/shut-down of a Generating Facility. The CAISO proposes the following principles for categorization of the different O&M costs:

Variable Operations Costs:

> *Variable Operations costs are the costs of consumables and other costs that vary directly with the electrical production (i.e., the run-hours, electricity output, or the start-up/shut-down) of a Generating Facility, specifically excluding maintenance costs, greenhouse gas allowance costs, fuel costs, and grid management charges.*

Variable Maintenance Costs:

> *Variable Maintenance costs are the costs associated with the repair, overhaul, replacement, or inspection of a Generating Facility that adhere to the following conditions:*
>
> 1) *Such costs must vary with the electrical production (i.e. the run-hours, electricity output, or the start-up/shut-down) of the Generating Facility.*
> 2) *Such costs should reflect future maintenance costs that are expected to be incurred within the service life of the major component of plant or equipment.*
> 3) *Such costs should be consistent with good utility practice.*
> 4) *Such costs should not effect a substantial betterment to the Generating Facility.*
> 5) *If the item is a replacement, it cannot be a replacement of an existing major component of plant or equipment.*

[1] Previous versions of this proposal used the term "definitions" to describe the language in this section. The CAISO believes that the term "principles" is more appropriate for this final proposal for two reasons: 1) the CAISO does not expect to include the language below in Appendix A to the CAISO Tariff, meaning that using the term "definitions" may be confusing in relation how this policy will be incorporated into the CAISO Tariff, and 2) the term "definitions" may imply that there is no ability to interpret the language in unforeseen circumstances or in situations requiring judgment and discretion. The CAISO does not intend for the principles to be completely flexible; rather, the use of the term "principles" acknowledges that real-life facts and circumstances may not fit neatly into fixed definitions. Hence, when confronted with an unanticipated circumstances or situations requiring discretion, the CAISO will consult the principles to aid in the categorization of O&M costs, instead of blindly applying definitions with no appreciation of the relevant facts and circumstances.

[2] The CAISO may find that it needs to revise the principles as phrased below when it prepares the proposed tariff changes for inclusion in the amendment to the CAISO Tariff to implement this final proposal. For example, the CAISO may determine that the principles for the categorization of Variable Maintenance costs should be broken out into sub-components that separately address such costs related to run-hours, to electricity output, and to start-up/shut-down. In any event, the CAISO will post the tariff changes for stakeholder review and comment before it finalizes and files them with FERC.

Fixed Costs:

> *Fixed costs include fixed maintenance, general and administrative, and other costs. Fixed maintenance costs are maintenance costs that do not vary with the electrical production (i.e. the run-hours, electricity output, or the start-up/shut-down) of the Generating Facility. General & administrative costs are non-maintenance costs incurred at a Generating Facility that do not vary with or relate to production (i.e. the run-hours, electricity output, or the start-up) of the Generating Facility. Other costs include any other plant-specific costs that are fixed in nature.*

O&M Cost Framework and Default O&M Adders

This section explains the proposed O&M cost framework and proposes default O&M Adder values by technology type.

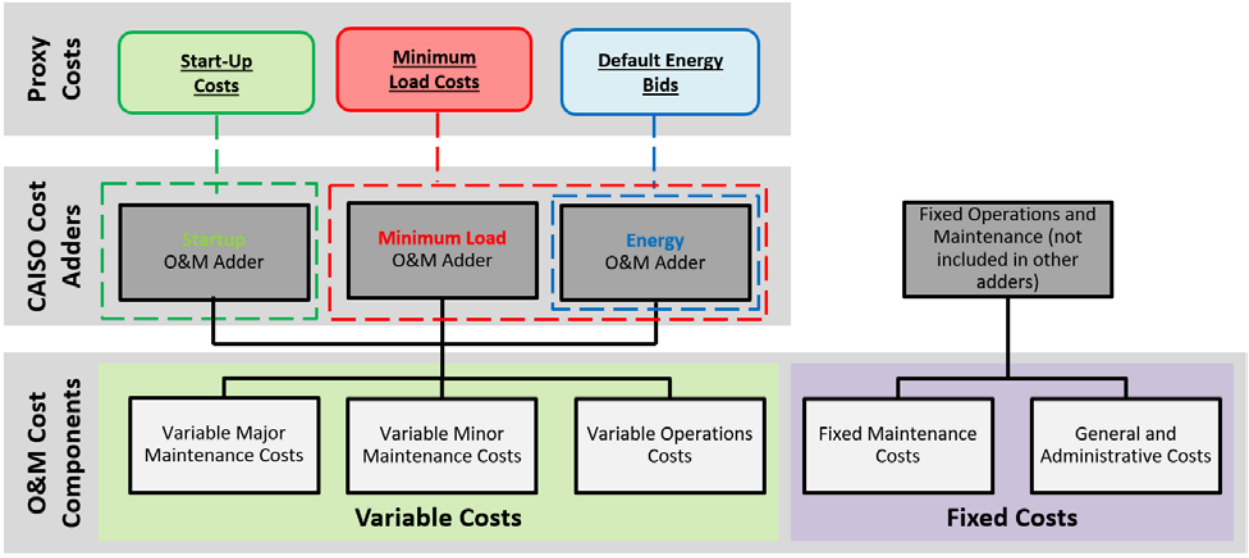
The proposed O&M cost framework allows *all* variable O&M cost components to be reflected in any of the three proxy costs[3]. This provides flexibility to market participants and gives them more ability to reflect their costs in the appropriate bid component. This is a departure from the current framework where only certain O&M cost components can be included in the bid components.

The default O&M Adders incorporate updated estimates for Variable Operations and Variable Maintenance costs developed over the past two years. There are three default O&M Adders: the Energy O&M Adder, the Minimum Load O&M Adder, and the Startup O&M Adder. The Minimum Load and Startup O&M Adders are analogous to the current major maintenance adders for minimum load and for startups and thus are included in the proxy minimum load costs and the proxy startup costs. The Energy O&M Adder is analogous to the current variable operations and maintenance adder and is thus included in the default energy bid and in proxy minimum load costs. Figure 3 shows this framework[4] visually.

[3] The term "proxy costs" refers to the CAISO's estimate of a resource's variable costs. Another term for this is reference levels. They are expressed in the same format as the three-part bid (energy bids, minimum load bids, and startup bids). These proxy costs are used as the basis for the default energy bid, the minimum load bid cap, and the startup bid cap that are used in mitigation of energy bids and in limiting the minimum load and startup bids.

[4] The cost framework may appear to be a change from the revised straw proposal but actually just represents a standardization of the language used. The definitions in the revised straw proposal allowed both Variable Operations costs and Variable Maintenance costs to be variable with respect to the run-hours, electricity output, or the start-up/shut-down, thus the representation presented above is a more accurate depiction of the proposal.

Figure 3 – Proposed Recovery Framework in CAISO Markets



In this initiative, the CAISO proposes default values for each of the three adders that will apply to all generating resources within a technology type. The default values for the Minimum Load and Startup O&M Adders represent the CAISO's estimate of Variable Maintenance costs and the default values for the Energy O&M Adders represent the CAISO's estimates of Variable Operations costs. Depending on the technology type, some O&M Adders have $0 default values. If the default values are found to be insufficient for specific resources, the framework continues to allow market participants to negotiate the O&M Adders. For example, if a market participant wishes to include Variable Maintenance costs in their Energy O&M adder, they can negotiate a custom Energy O&M adder with the CAISO[5]. See Table 1 for the default O&M Adder values.

Table 1 – Proposed default O&M Adder values

Technology Type	**Energy O&M Adder *($/MWh)***	**Minimum Load O&M Adder *($/run-hour/MW[6])***	**Startup O&M Adder *($/start/MW)***
Default values represents:	*Variable Operations Costs*	*Variable Maintenance Costs*	*Variable Maintenance Costs*
Coal	2.69	-	-
Steam Turbines	0.33	-	-
CCGTs	0.59	1.74	-
[Frame] CTs	0.97	-	52.13
Aeroderivative CTs	2.15	4.38	-

[5] There are a few minor exceptions to this statement in regards to how resources with existing MMA or VOM adders can negotiate custom O&M Adder values. See Appendix D for more details.

[6] The default Minimum Load and Startup O&M Adders are expressed in $/run-hour/MW and $/startup/MW units, respectively. To arrive at a resource-specific O&M Adder, the CAISO will multiply the proposed default value by the Pmax of the resource or configuration. This results in the resource-specific Minimum Load and Startup O&M Adders being expressed in $/run-hour or $/startup units, respectively.

RICEs	1.10	-	-
Nuclear	1.08	-	-
Biomass Power Plant	1.65	-	-
Geothermal Power Plant	1.16	-	-
Land Fill Gas	1.21	-	-
Hydro	-	0.65	-
Solar	-	-	-
Wind	0.28	-	-
Storage/NGRs/PDRs/RDRRs	-	-	-

The O&M Adder values in Table 1 were developed in two ways: the Energy O&M Adder was developed by external consultant Nexant as an estimate of Variable Operations costs[7] and the Minimum Load O&M Adder and the Startup O&M Adders were developed by the CAISO as an estimate of Variable Maintenance costs. The report issued by Nexant is included as Appendix F and the cost calculations developed by the CAISO are included as Appendix B. This delineation of estimates allowed for a clean separation of VM and VM costs resulting in what the CAISO believes is a conservative yet useful set of default values.

Key issues addressed in the development of the default O&M Adders

The main body of this paper will focus on a few key issues faced when developing these adders while much of the calculation detail and assumptions will be discussed in the Appendices. The key issues discussed here are the:

- *Cost estimation principles*
- *Technology grouping*
- *Methodology used to arrive at VM cost estimates*
- *Changes to the VM calculation methodology between the revised straw proposal and the final proposal*

Cost estimation principles

A key principle affecting the CAISO's estimates is that the estimates need to be sufficiently conservative while also still attractive for use in lieu of negotiated O&M Adder values. Ensuring our estimates are conservative is important for a few reasons. First, these values are used in local market power mitigation to ensure that resources with the ability to exercise local market power cannot bid above their costs. Proxy cost estimates greater than resources' costs introduce a potential inefficiency into the market if these proxy costs clear the market. Second, once the values are in place, only resources with costs higher than the defaults will approach the CAISO to negotiate their adders. If the default values are too high, the CAISO will have no visibility into whether resources' actual costs exceed the proposed estimates. However, the concept of the default Minimum Load and Startup O&M Adders is being introduced to balance with the associated administrative burden of processing many resource-specific negotiations for both market participants and the CAISO. The CAISO believes the proposed default

[7] The exception to this is the VO cost estimate for wind resources that were developed internally by the CAISO. See Appendix E for the detailed calculation.

values are a reasonable balance between being conservative while also useful for participants as default values.

The CAISO also applies several principles in selecting the external sources of O&M cost estimates. The CAISO has identified publicly available sources that are appropriate definition-wise, geographically appropriate (or could be converted across geography), temporally applicable (or could be converted across time), technologically appropriate, and credible. The CAISO also strives to use a calculation methodology that is responsive to the data constraints presented for each technology type. These principles help the CAISO ensure that the O&M cost estimates used in the default O&M Adder values are accurate and defensible.

Technology grouping

The proposed default VM values cover four technology types covering approximately 75% of resources with identifiable VM costs[8]. The CAISO strives to group technologies at a level that is sufficiently granular to capture cost differences between technologies while also being sufficiently aggregated to be widely applicable and not exclude technologies. In cases where a technology group was commonly represented by a particular technology type (e.g. 55% of Aeroderivative CTs in the CAISO/EIM footprint are GE LM6000s), those technologies are used as "representative technologies" and cost estimates for these particular technologies are used. For those technology groups that do not have default values, the CAISO either believes that the technology group does not have Variable Operation or Variable Maintenance costs (e.g. the Solar technology group) or insufficient data exist to estimate these costs that abide by our cost estimation principles (e.g. the Steam technology group).

Changes to the VM calculation methodology from the revised straw proposal to the final proposal

In this final proposal, the CAISO has changed a few aspects of the calculation presented in the revised straw proposal. The revised straw proposal offered two options to calculate the default VM costs and requested that stakeholder weigh in on their preferred option. Because the feedback did not favor one option over the other, the CAISO primarily uses "Option 1" as discussed in the revised straw proposal. This option is characterized by using a single external source per technology type and using no unit conversions that rely on CAISO-developed conversion factors. The exception to this is Hydro resources, which uses an approach similar to "Option 2" as discussed in the revised straw proposal.

The CAISO's decision to use this blended approach of Option 1 and Option 2 is informed by stakeholder feedback and guided by the cost estimation principles discussed above. The blended approach is similar to the approach discussed by PGE in their comments to the revised straw proposal and is responsive to the concerns expressed by DMM and other stakeholders. Using Option 1 for gas technologies represents a conservative approach to developing the cost estimates as it involves fewer assumptions and has the benefit of simplicity. The external sources for the gas technologies also have technology-specific (e.g. LM6000-specific) cost estimates and, thus, using a single source is preferred. Using Option 2 for hydro technologies is appropriate as detailed technology-specific cost estimates are not as widely available for hydro resources as they are for gas resources; thus a diversity of estimates better suits the hydro technology group. The hydro cost estimates involve only a few assumptions that the CAISO believes that

[8] For the purposes of this calculation, the CAISO ignores technology types which don't have maintenance activities which can be specifically linked to their variable production (e.g. solar photovoltaic resources).

the assumptions are adequately supported. The CAISO views the differences in approach as a strength in our methodology, rather an inconsistency or a flaw, because the differences are responsive to the unique challenges posed by estimating costs for gas versus hydro technologies.

Methodology used to arrive at VM cost estimates

The process the CAISO uses to calculate the VM cost estimates which are the basis of the default Minimum Load and Startup O&M Adders consists of five steps. While these steps are shown in greater detail in Appendix B, this section will discuss each step briefly.

1) Estimate variable maintenance costs using external sources
2) Determine which adder type ($/run-hour, $/start, or $/MWh adder) is most appropriate for each technology type
3) Convert the variable maintenance costs to the appropriate adder type
4) Cross-validate the estimate from external sources against median major maintenance adder values to determine a default O&M Adder value
5) Using the default O&M Adder value, calculate a resource-specific O&M Adder

Step 1: Estimate variable maintenance costs using external sources

The CAISO uses external sources to estimate VM costs. As discussed above, the CAISO considers several criteria to ensure that the external sources used are appropriate. Ultimately, the CAISO uses four sources based on those criteria: NYISO (2010), NYISO (2016), EPA (2018), and EIA (2020). The CAISO then gathers the cost data from the source documentation and converts the costs estimates to factor in differences in costs arising from temporal and geographic differences.

Step 2: Determine which adder type ($/run-hour, $/start, or $/MWh adder) is most appropriate for each technology type

Once the external estimates have been converted to consistent units, the CAISO needs to determine which adder type is most appropriate as a default value for each technology type. Because the CAISO proposes to apply the default values to all resources within a technology type, the CAISO must determine a default adder type for each technology. To do so, the CAISO considers which factor typically most influences maintenance actions (*i.e.* whether starts, run-hours, or MWh are the primary drivers of maintenance costs) and which type of MMA is currently most prevalent for that technology type. Based on this, the CAISO proposes that the default adder for the Aeroderivative CT, CCGT, and Hydro technology types are best represented by a $/run-hour default value, while frame CTs are best represented by a $/start default value.

Step 3: Convert the variable maintenance costs to the appropriate adder type

The external cost estimates are not presented in the adder type format that is proposed in Step 2. This conversion is a simple mathematical exercise and uses unit conversion factors found in the source documentation (gas resources) or derived from CAISO and EIM operating data (hydro resources).

Step 4: Cross-validate the estimate from external sources against median major maintenance adder values to determine a default O&M Adder value

The CAISO proposes to limit the proposed default VM cost values to the median of currently approved MMA values. This is in accordance with the CAISO's principle that the estimates should be sufficiently conservative while also still attractive for use in lieu of negotiated O&M Adder values. For technology types in which the external sources exceed the median MMA values, the CAISO will use the median of the MMA values. The median value was calculated for only those technology types with a sufficient number of MMAs[9].

The CAISO presents the proposed default O&M Adders in Table 2. Table 2 also shows the median MMA values for those technologies where the external estimate exceed the median MMA values. For the technologies where the median value negotiated MMAs exceed the external estimates, the CAISO is not disclosing these values for confidentiality purposes. The far right column shows the proposed default O&M Adder calculated as follows for each technology type:

Default O&M Adder = min (External Estimate VM Costs, Median MMA Value)

Table 2 – Proposed default O&M Adder values

Technology Type	External Estimate VM Costs	Median MMA Values	Default O&M Adders	Units
CCGTs	1.74	-	1.74	$/run-hour per MW
[Frame] CTs	52.13	-	52.13	$/start per MW
Aeroderivative CTs	4.38	-	4.38	$/run-hour per MW
Hydro	1.12	0.65	0.65	$/run-hour per MW

Step 5 – Using the default O&M Adder value, calculate a resource-specific O&M Adder

The CAISO proposes to use of the maximum generating capacity of the resource (*i.e.,* its Pmax) to scale default O&M Adder to be a resource-specific O&M Adder. If the resource is a multi-stage generator (MSG), the CAISO proposes to calculate the resource-specific O&M Adder using the Pmax of each configuration to reflect the incremental costs of wear-and-tear of operating of each configuration. Note that this logic only applies to the Minimum Load and Startup O&M Adders; the Energy O&M Adder is not scaled by the Pmax of the resource or configuration. The resulting unit-specific adder calculation is proposed as follows:

*Resource-specific O&M Adder = Default O&M Adder * Resource's Pmax*

Or if the resource is a multi-stage generator (MSG):

*Configuration-specific O&M Adder = Default O&M Adder * Configuration's Pmax*

The resource-specific or configuration-specific O&M Adder will then be used by the CAISO systems to calculate the minimum load bid cap or the startup bid cap.

[9] The CAISO concludes that a sufficient number of MMAs was that the technology type has to have at least 20 resources with negotiated MMAs based on actual costs, rather than PPAs or LTSAs. For multi-stage generators, the CAISO uses only the first configuration or, in the case of CCGTs, the 1X1 configuration for the purposes of this calculation.

V. EIM Decisional Classification

This initiative proposes to modify rules for establishing variable operations and maintenance cost values in the CAISO's estimates of generating resources' costs used for market power mitigation.

An initiative proposing to change rules of the real-time market falls within the primary authority of the EIM Governing Body either if the proposed new rule is EIM-specific in the sense that it applies uniquely or differently in the balancing authority areas of EIM Entities, as opposed to a generally applicable rule, or for proposed market rules that are generally applicable, if "an issue that is specific to the EIM balancing authority areas is the primary driver for the proposed change."

At this stage of the initiative, it does not appear it would satisfy the first test, because any proposed rule changes would be generally applicable to the entire CAISO market footprint, both the real-time and day-ahead market, and thus are not EIM-specific. Moreover, the primary driver for addressing these topics is not specific to the EIM balancing authority areas. Rather, the initiative stems from issues raised in an internally-driven review of these costs. Accordingly, this initiative would fall entirely within the advisory role of the EIM Governing Body.

VI. Stakeholder Timeline

The schedule for stakeholder engagement is detailed below in Table 3. The CAISO will discuss this final proposal paper with stakeholders during a call on October 29 at 09:00AM PT. Stakeholders can submit written comments regarding this final proposal paper by November 12, 2020 through the CAISO's new commenting tool.

Please note that the dates below are tentative until the CAISO publishes a notice formally confirming them.

Table 3 – Stakeholder timeline

Date	Milestones
December 19, 2019	Post Straw Proposal
January 6, 2019	Hold stakeholder call on Straw Proposal
January 21, 2019	Stakeholder written comments due on Straw Proposal
May 4, 2020	Post Revised Straw Proposal
May 11, 2020	Hold stakeholder call on Revised Straw Proposal
May 26, 2020	Stakeholder written comments due on Revised Straw Proposal
August 12, 2020	Post Draft Final Proposal
August 19, 2020	Hold stakeholder call on Draft Final Proposal
September 3, 2020	Stakeholder comments due on Draft Final Proposal
Aug. 2020 - Jan. 2021	Tariff & BRS Development

October 22, 2020	Post Final Proposal
October 29, 2020	Hold stakeholder call on Final Proposal
November 4, 2020	EIM Governing Body
November 12, 2020	Stakeholder comments due on Final Proposal
November 18-19, 2020	Board of Governors

VII. References

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VIII. Appendices

A) Principles – Interpretive Guidance

This section will provide interpretive guidance on Variable Operations and Variable Maintenance costs and will offer specific guidance on labor costs that applies to both cost categories.

Variable Operations Costs

Variable Operations costs are the costs of consumables and other costs that vary directly with the electrical production (i.e., the run-hours, electricity output, or the start-up/shut-down) of a Generating Facility, specifically excluding maintenance costs, greenhouse gas allowance costs, fuel costs, and grid management charges.

As explained in the principle above, Variable Operations (VO) costs arise directly as a result of operating the Generating Facility but don't include maintenance, greenhouse gas allowance, or fuel costs. Examples of VO costs include consumable materials, production-based fees such as royalties paid to landowners, and costs associated with the energy needed to cool critical components. These costs also exclude existing costs in reference levels such as the grid management charge and opportunity cost adders.

The CAISO will outline a few specific examples here to further define VO costs:

- Consumables specifically include raw and demineralized water, boiler chemicals, cooling tower chemicals, and ammonia.
- Production-based fees such as royalties paid to landowners are VO costs. The CAISO would expect to see these fees spelled out explicitly in a contract such as a power purchase agreement (PPA) or in enacted regulation (e.g. fees due to FERC or other regulatory authorities/groups).
- VO costs also include cost of consumables and other costs related to pre-start, start, shutdown activities, and return to pre-start stand-by conditions as long as the costs can be clearly demonstrated as variable.

Variable Maintenance Costs

Variable Maintenance costs include costs that are incurred when repairing, overhauling, and inspecting the Generating Facility. Costs of replacing equipment may also be included under specific circumstances such as replacing a non-major component due to the wear-and-tear of operating the component. Examples of Variable Maintenance activities include hot gas path inspections, combustion inspections, and major overhauls inspections. Routine maintenance including standby maintenance performed during off-peak periods may also be Variable Maintenance as long as the maintenance activities vary with the electrical production of the unit.

The CAISO stresses that these costs are those that vary with the electrical production of the unit; they arise due to the wear-and-tear on the Generating Facility because it is engaged in the production of electricity. Further, they are costs incurred to maintain the Generating Facility, not to substantially alter it beyond its original characteristics.

This section provides interpretative guidance on the components of the principles for the categorization of Variable Maintenance costs. The CAISO expects to include this guidance in the BPMs upon

implementation of this initiative. This guidance is intended to be useful during the negotiation of custom O&M Adders and may also inform the CAISO's estimate of the default O&M adder values. As a reminder, the principles for the categorization of Variable Maintenance costs are included below; any underlined terms are interpreted further below.

Variable Maintenance costs are the costs associated with the repair, overhaul, replacement, or inspection of a Generating Facility that adhere to the following conditions:

1) *Such costs must vary with the electrical production (i.e. the run-hours, electricity output, or the start-up/shut-down) of the Generating Facility.*
2) *Such costs should reflect future maintenance costs that are expected to be incurred within the service life of the major component of plant or equipment.*
3) *Such costs should be consistent with good utility practice.*
4) *Such costs should not effect a substantial betterment to the Generating Facility.*
5) *If the item is a replacement, it cannot be a replacement of an existing major component of plant or equipment.*

Costs must vary with the electrical production

This is the core principle of variable costs and is often the deciding factor in determining whether a cost is Variable Maintenance or not. For the purposes of O&M costs, the CAISO analyses electrical production in three ways: 1) the electricity output of the resource measured in terms of MWh, 2) the length of time that the unit is committed and producing electricity at or above its minimum load measured in terms of run-hours, and 3) the frequency of starting up the resource or, if the resource is a multi-stage generator, transitioning to higher configurations. This means that, for a maintenance cost to be considered variable, it must vary with respect to one of these three measures. Costs that are incurred regardless of these measures are by definition fixed. Fixed costs are not recoverable via the CAISO's spot energy markets. The CAISO recognizes that there are sometimes situations where the maintenance initially appears to be calendar based, but is actually production based; this is discussed this in more detail below.

Start-up/shut-down

VM costs also include cost of repair, overhaul, replacement, or inspection related to pre-start, start, shutdown activities, and return to pre-start stand-by conditions as long as the costs can be clearly demonstrated as variable.

Generating Facility

This term is defined in the Tariff as "*An Interconnection Customer's Generating Unit(s) used for the production and/or storage for later injection of electricity identified in the Interconnection Request, but shall not include the Interconnection Customer's Interconnection Facilities*." For the purposes of negotiating custom O&M Adders, this will broadly include the major components of the Generating Unit and any plant or equipment in the Generating Facility whose maintenance activities can be shown to vary with electrical production.

Future maintenance costs

This term means that the costs must be reasonably expected to be incurred at some point in the future. Historical, *i.e.* sunk, costs cannot be included in the O&M Adder. However, historical costs are often useful in estimating future costs. In this case, historical costs can be used as a starting point in estimating future maintenance costs as long as the costs are reasonably expected to be incurred in the future. For example, resources may discover the need for unplanned maintenance during an inspection. If the maintenance has already been performed, the cost to repair these specific issues cannot be included in the O&M Adder. However, these unplanned maintenance activities may be an indication that the resource can expect to incur more unplanned maintenance costs in the future for similar reasons. If so, and the market participant can demonstrate that the remaining conditions of the principles are met, the estimate of the costs for unplanned maintenance to be performed in the future would be considered Variable Maintenance costs.

Service life (and maintenance intervals)

Service Life understanding:

This term is consistent with the term used in the FERC Uniform System of Accounts (USoA) and is assessed at the major component level (see further discussion below). Service life means the period between the date that property is placed in service and the expected date of its replacement or retirement. Because the major component is an integral part of the Generating Facility, the service life of a major component cannot exceed the service life of the Generating Facility as a whole.

Major components' service life may be defined in terms of production or in terms of calendar time. In the former case, service life can be presented in terms of run-hours, start-ups/shut-downs, MWh production, a permutation of these factors (e.g. factored hours), or a blend of these factors. Service life may also be defined to terms of calendar time.

As a Generation Facility approaches the end of its service life, the SC and resource owner will be confronted with the decision to either perform maintenance actions or retire the resource. This decision will be made based on a variety of regulatory, operations, and financial factors into which the CAISO will not have clear transparency. In these cases, it may not be obvious that the maintenance actions included in the application will be performed prior to the resource reaching the end of its life.

In such situations, the CAISO will ask the SC to support their claim that they will perform the maintenance activities in their application. Such support could include letters from plant engineers about their expectation to perform maintenance outside of OEM recommendation, future expectations of how frequently the resource will cycle, etc. Because of the uncertainty around retirement decisions, the CAISO will not assess *how well* the documentation supports the SC's claim but rather only *whether or not* it supports the SC's claim. In cases where the SC is unable to support their claim that maintenance activities included in the application are indeed expected to be performed, the CAISO will not consider the wear-and-tear due to the operation of the resource as a Variable Maintenance cost. In other words, reductions in the value of the resource due to the operation of the resource arising from wear-and-tear that will never be repaired or remediated are

not considered a Variable Maintenance cost. This is consistent with the CAISO's historical practice of only allowing expected maintenance costs to be included in the MMA and negotiated VOM adder.

Maintenance Intervals understanding:

While not explicitly included in the principle above, the CAISO will refer to maintenance intervals as they are related conceptually to service life. In practice, the maintenance interval is usually defined in terms of either production or calendar time. If the maintenance interval is in terms of production (e.g. perform a hot gas path inspection once every 25,000 hours), the costs vary with production and, thus, will be considered Variable Maintenance, subject to the other conditions of the principles.

If the maintenance interval is in terms of calendar time (e.g. perform a hot gas path inspection every 10 years), the situation is more complicated. If the maintenance will be performed regardless of production at the end of the maintenance interval, the costs are not Variable Maintenance costs. However, as DMM points out in their comments to the revised straw proposal, there are sometimes situations where the maintenance initially appears to be calendar based, but is actually production based. For example, a 10-year maintenance interval may be initially defined in terms of calendar time. However, implicit in the estimate of the 10 years is an expectation of how many hours per year the major component will be used (e.g. 2,500 hours per year for 10 years) because of the wear-and-tear on the unit. In this case, the maintenance interval in terms of production (in this example, 25,000 hours) may actually be more appropriate.

Major component

The CAISO uses the term "major component" in two situations: 1) in considering the unit of account for assessing service life, and 2) in considering whether a replacement is a Variable Maintenance costs or not. The major component is the "unit of account" on which we consider these two issues. The unit of account is the level at which the CAISO proposes to group plant and equipment. For example, for frame combustion turbines, we define the major components, and thus the units of account, to be 1) the gas turbine and 2) the generator. The CAISO understands that the individual facts and circumstances of plants vary and thus these major component classifications are only a starting point. The CAISO considered alternatives to this level of aggregation that were less granular (e.g. the entire Generating Facility) or more granular (the compressor, the combustion system, etc.). However, the CAISO believes that the major components represent a reasonable balance between levels of aggregation and are representative of the industry standard.

Generally, during O&M Adder negotiations, the CAISO will assess the service life at the major component level unless a valid reason can be supplied for such an alternative treatment.

During O&M negotiations, the CAISO will not consider replacement of *major components* to be Variable Maintenance. However, the CAISO will consider replacement of *the constituent parts of the major component* to be Variable Maintenance, provided that they meet the remaining conditions of the principles outlined above. For example, if the entire turbine needs to be replaced, the costs associated with this would not be consider Variable Maintenance costs. The rationale for this is that this replacement is not serving to return the major component to a state similar to its original condition (*i.e.* maintaining it) but rather replacing it entirely. A counterexample to this is a replacement of a compressor; in this case, the replacement of the compressor is a constituent part of the major

component and thus would be a Variable Maintenance cost (assuming the other conditions in the principles are met). The replacement of the constituent part (*i.e.* the compressor) is performed in order to bring the major component (*i.e.* the turbine) back to its original condition; in other words, the replacement was performed to maintain the turbine. The unit of account distinction is crucial here because the CAISO needs to be able to distinguish the treatment of the turbine from the treatment of the turbine blade. Table 4 shows the list of typical major components by technology:

Table 4 – Typical major components by technology

- Frame and Aeroderivative CTs
  - Gas turbine
  - Generator

- Combined Cycle Gas Turbines
  - Gas turbine
  - Steam turbine
  - Generator
  - Heat recovery steam generator

- Biomass
  - Turbine
  - Generator
  - Feedwater system/condensate
  - Boiler

- Geothermal
  - Steam turbine
  - Generator
  - Feedwater system/condensate

- Coal and Steam Turbines
  - Steam turbine
  - Generator
  - Feedwater system/condensate
  - Boiler
  - Pulverizer

- Hydro
  - Turbine
  - Generator
  - Penstock/intake structure
  - Penstock control gates
  - Trash racks
  - Power house
  - Reservoir/dams

- Nuclear
  - Steam turbine
  - Generator
  - Steam generators
  - Feedwater system
  - Reactor vessel
  - Reactor cooling pumps

- Internal Combustion Engines
  - Engine
  - Generator

Other technology types: No defined major components, these will be assessed during individual negotiations

Good utility practice

A summary of the FERC definition of Good Utility Practice is:

- Any practices, methods, or acts engaged in or approved by a significant portion of the electric utility industry, or

- Any practices, methods, or acts which, in the exercise of reasonable judgement, could have been expected to accomplish the desired result at a reasonable cost consistent with good business practice, reliability, safety, and expedition.

Substantial betterment

A substantial betterment is an action "*the primary aim of which is to make the property affected more useful, more efficient, of greater durability, or of greater capacity*". Substantial betterments improve a resource, not maintain it, and thus are not Variable Maintenance costs.

FERC also notes: "*When a minor item of depreciable property is replaced independently of the retirement unit of which it is a part, the cost of replacement shall be charged to the maintenance account appropriate for the item, except that if the replacement effects a substantial betterment …, the excess cost of the replacement over the estimated cost at current prices of replacing without betterment shall be charged to the appropriate electric plant account.*" Applying this logic to the CAISO's principles, this means that the some of the costs of a maintenance action that results in a substantial betterment may be considered Variable Maintenance costs and some may not. The "*excess costs of the replacement over the estimated cost at current prices of replacing without betterment*" will not be Variable Maintenance costs while the remaining costs will be.

Table 5 maps the enumerated criteria in the substantial betterment definition to the corresponding Master File/RDT fields. This table isn't intended to be exhaustive but rather illustrative.

Table 5 – Mapping of substantial betterment criteria to Master File/RDT fields

Criteria	***Master File field***	***A substantial betterment if the action…***
More useful	FUEL_TYPE	Allows the resource to burn multiple types of fuel
	CONFIGURATION	Allows the resource to operate as a multi-stage generator, e.g. by creating steam augmentation or duct-firing capability
More efficient	HEAT_RATE	Decreases the average heat rate of the resource/segment beyond its original operating characteristics
	AVERAGE_COST	Decreases the average cost of the non-gas resource/segment beyond its original operating characteristics
Greater durability	N/A	Increases the service life of the major component beyond its original design
Greater capacity	MAX_GEN	Action increases the Pmax of the resource beyond its original design

While this seems simple, the practical application of this is not as clear as it seems. Some activities serve both to bring the resource back to its original condition but also to improve it. In this case, some of the costs can be Variable Maintenance costs while some are not. The CAISO shows multiple scenarios below which may help in considering how to treat substantial betterments to

the resource and proposes some potential cost allocation methodologies. These scenarios presuppose that the other conditions in the Variable Maintenance principles are also met.

Scenario 1 – Steam turbine
Service Life: Partially complete (20,000 hours left)
Replacement: Sub-component of a major component (e.g. compressor)
Effects a betterment?: No
Treatment: Cost of replacement is a Variable Maintenance cost

Scenario 2 – Steam turbine
Service Life: Complete
Replacement: Major component (e.g. entire turbine)
Effects a betterment?: N/A – turbine is no longer serviceable
Treatment: Cost of replacement is not a Variable Maintenance cost

Scenario 3 – Steam turbine
Service Life: Partially complete (10,000 hours left)
Replacement: Major component (e.g. entire turbine)
Effects a betterment?: N/A – turbine is being replaced
Treatment: Cost of replacement is not a Variable Maintenance cost

Scenario 4 – Steam turbine
Service Life: Partially complete (20,000 hours left, turbine efficiency has decreased by 5% due to operation of the unit)
Replacement: N/A – applying a new coating
Effects a betterment?: Yes, the primary aim of applying the new coating is to make the turbine more efficient (*i.e.* decrease its heat rate).
Treatment: Some of the costs are Variable Maintenance costs while some are not. The percentage of costs that *do not* effect a betterment are Variable Maintenance costs, the remainder are not.

Other terminology for maintenance activities (e.g. preventative, predictive, corrective, routine, major, and minor maintenance costs)

The CAISO recognizes that there are number of different terms used by the industry to refer to different maintenance activities. In previous iterations of this proposal, the CAISO strove to develop definitions for these terms to aid our purposes. However, these terms ended up being contentious, difficult to define, and, ultimately, not useful for our end goals. We are aware of these terms and may indeed use them during O&M Adder negotiations but, for the purposes of the principles proposed herein, they will not be used. In particular, the distinction between major and minor maintenance does not have a standardized definition and is unnecessary if the principles above are applied appropriately.

Labor Costs

The cost of labor can be included in any of the cost components discussed above. The difficulty faced by market participants and the CAISO during negotiations is how to bucket the labor costs between the fixed and variable components. Consistent with the CAISO's proposed approach for non-labor variable costs, labor costs should be considered variable if they vary with production of the Generating Facility. To determine this, the CAISO proposes that the labor costs must be linked with the associated operations and maintenance activity.

For example, regular, salaried staff may be involved in the performance of maintenance work on a turbine blade that needs to be repaired due to wear-and-tear from starting the unit. In this case, the actual dollar-value of the labor cost wouldn't fluctuate with output, run-hours, or starts because the employee is salaried. However, because the turbine blade needed to be replaced due to the variable operation of the unit, the component of the salaried worker's pay related to this repair should be considered variable and thus included in Variable Maintenance costs. If a contractor is brought in to perform this same work, the cost of the contractor would also be considered as a Variable Maintenance cost for the same reason.

In an opposite example, a contractor or personnel from another plant are brought in to perform routine, annual maintenance on the road leading to the facility (the wear-and-tear on which can be reasonably expected to *not* vary with MWh output, run-hours, or starts of the generating unit). Because the associated maintenance activity isn't affected by the operation of the unit, these costs would be considered to be Fixed Maintenance.

The CAISO recognizes that these are simplified cases and that the reality may be complicated by differences in accounting/payroll systems, business practices, etc. Accordingly, the CAISO encourages stakeholders to share their thoughts and bring up specific scenarios during this stakeholder process.

B) Default Variable Maintenance Costs Calculation

This appendix provides the narrative context for the calculation of the default Variable Maintenance (VM) costs used as the basis for the default Minimum Load and Startup O&M Adders. The detailed numerical calculations are included as an Excel spreadsheet attached separately on the webpage.

The proposed default VM values cover four technology types covering approximately 75% of resources with identifiable VM costs. The primary reason that the CAISO does not propose default VM values for all technology types is that there are not enough currently negotiated MMAs of those technology types. Without a sufficient number of negotiated MMAs, the CAISO is unable to cross-validate the external estimates to ensure their conservativeness.

The VM cost estimates are calculated using a five-step process:

1) Estimate variable maintenance costs using external sources
2) Determine which adder type ($/run-hour, $/start, or $/MWh adder) is most appropriate for each technology type

3) Convert the variable maintenance costs to the appropriate adder type
4) Cross-validate the estimate from external sources against median major maintenance adder values to determine a default O&M Adder value
5) Using the default O&M Adder value, calculate a resource-specific O&M Adder

Step 1: Estimate variable maintenance costs using external sources

The CAISO uses external sources to estimate VM costs. As discussed above, the CAISO considers several criteria to ensure that the external sources used are appropriate. Ultimately, the CAISO uses four sources based on those criteria: NYISO (2010), NYISO (2016), EPA (2018), and EIA (2020).

The CAISO considers several criteria when selecting the external sources to use as the basis of the estimation of variable maintenance costs:

- **Definitional appropriateness**: The CAISO uses sources that have definitions of variable maintenance costs similar to the principles proposed above. Sources that specifically mention that their estimates include major maintenance costs, the largest component of variable maintenance costs, are preferred over those that did not. On this basis, the NYISO reports are the most consistent with the CAISO's proposed definitions for gas resources. Other sources considered usually did not specifically enumerate their definitions of VOM costs.
- **Geographical applicability:** Where possible, the CAISO used sources that apply to the CAISO/EIM footprint but, in some cases, the report does not apply specifically to these areas. In the case of the NYISO reports, the CAISO translates the labor component to WECC region-specific costs using a geographic weighting factor. In the case of the EIA and EPA reports, the CAISO assumes that the costs in the geographic area covered in those reports (*i.e.* the entire United States) is similar to those in the CAISO/EIM footprint.
- **Temporal applicability:** The CAISO uses only maintenance cost sources published within the past 10 years, as these would best reflect the recent changes to the energy system.
- **Technological appropriateness:** The CAISO only uses estimates from external sources if the turbine technology was representative of the resources in the CAISO/EIM footprint. The exception to this is hydro resources, where technology-specific data is typically not presented.
- **Credibility:** The CAISO chooses sources that are reputable, unbiased, and, ideally, from equipment manufacturers or operators. The CAISO prefers sources that were filed with regulatory bodies, such as public utility commissions, over those released for informational purposes only.

The CAISO considers certain technology types to be representative of the resources in the CAISO/EIM footprint. These representative technologies serve as the basis of the CAISO's determination of default values, both for VM and for VO costs. The CAISO recognizes that other turbine types are present in the CAISO/EIM operating areas. However, the technologies listed below are either the most common types or have the most readily accessible O&M cost information. The default VM and VO costs for these representative technologies apply to all resources within that technology group. For example, the default VM and VO costs for F-class CCGTs will apply to all CCGTs within the CAISO/EIM footprint.

The CAISO proposes that the following turbine technology types should be considered representative:

- CCGTs: F-class CCGTs
- (Frame) Combustion Turbines: F-class CTs

- Aeroderivative CTs: GE LM6000

The CAISO then gathers the cost data from the source documentation and converts the costs estimates to factor in differences in costs arising from temporal and geographic differences. For the hydro estimates, the CAISO converts the source documentation from a $/MWh value to a $/year value by using a capacity factor of 33%. See tabs 1a, 1b, and 1c in the Supporting Calculations spreadsheet for the details of these calculations.

Step 2: Determine which adder type is most appropriate for each technology type

Once the external estimates have been converted to consistent units, the CAISO needs to determine which adder type is most appropriate as a default value for each technology type. Because the CAISO proposes to apply the default values to all resources within a technology type[10], the CAISO must determine a default adder type for each technology. This CAISO would like to stress that these adder types are the *default* adder type and, should a market participant wish for their adders to be expressed in a different format, they can negotiate a resource-specific O&M Adder with the CAISO.

The rationale for the CAISO's determination of the default adder type by technology is:

- **CCGTs:** the CAISO proposes a $/run-hour default value based on the ratio of MMA costs which are currently reflected in a $/run-hour format (~60%). Also, the CAISO believes that, on average, CCGT maintenance cycles will be driven by run-hours rather than starts. The NYISO report uses a ratio of run-hours/starts of 27 to determine whether a technology's maintenance cycle will be driven by starts or run-hours. If the ratio is below 27, the cycle will be driven by starts and vice versa. The CAISO/EIM operating data indicates that ratio is closer to 34 run-hours/start indicating that the cycle will be driven by run-hours.
- **[Frame] CTs:** the CAISO proposes to use a $/start default value based on the set of existing MMAs. Approximately 99% of existing MMA costs are reflected in a $/start format indicating that the maintenance cycles are typically driven by starts, rather than run-hours. Also, in its comments on the straw proposal, APS noted that approximately 90% of variable maintenance costs of its frame CTs are driven by starts.
- **Aeroderivative CTs:** the CAISO proposes a $/run-hour default value based on the ratio of MMA costs which are reflected in a $/run-hour format (~57%). This is consistent with the 2010 NYISO report that indicates that maintenance cycles for aeroderivative CTs are driven by run-hours.
- **Hydro:** the CAISO proposes a $/run-hour default value. MMA costs are relatively evenly split between $/run-hours and $/start for Hydro resources. Based on the CAISO's recent experience, the CAISO believes that Hydro resources are more likely to incur costs based on run-hours, rather than starts. This is because most hydro resources are modelled as non-MSGs despite having multiple turbines. Accordingly, many dispatches between Pmin and Pmax, may actually result in additional turbines being committed. The CAISO market will not recognize these as starts/transitions, meaning that a $/start adder will be used much less frequently.

[10] Except for resources that already have a negotiated MMA. See *Implementation of new default values* section for more discussion of how the default values will be applied.

Step 3: Convert the variable maintenance costs to the appropriate adder type

The external cost estimates are not presented in the adder type format that is proposed in Step 2. For gas resources, the CAISO performs a simple conversion using the starts/cycle or run-hours/cycle conversion factors found in the NYISO source documentation. For hydro resources, the conversions needed are slightly more complicated and involve operating data (run-hours per year) from the CAISO and EIM areas. See the Step 3 tab in the Supporting Calculations spreadsheet for the details of these calculations.

Step 4: Cross-validate the estimate from external sources against median major maintenance adder values to determine a default O&M Adder value

As noted in the main body of the paper, a key principle affecting the CAISO's estimates is that the estimates need to be sufficiently conservative while also still attractive for use in lieu of negotiated values. To balance these two competing goals, the CAISO proposes to limit the proposed default VM cost values to the median of currently approved MMA values. For technology types in which the external sources exceed the median MMA values, the CAISO will use the median of the MMA values. The median MMA value is used in lieu of the mean or an interpolated[11] to mitigate the impact of outlier MMA values. The median value was calculated for only those technology types with a sufficient number of MMAs[12]. The CAISO also assesses whether the resources with MMAs are a reasonable cross-section of the resources within the CAISO/EIM footprint, noting that the resources with MMAs were substantially in line with the bulk of resources in the CAISO markets.

This approach has two important implications. The first is that the CAISO can only calculate robust default O&M adders for four technology types. Only these four technology types have a sufficient sample size of existing MMAs against which the CAISO could reasonably check the estimates. The second implication is that the CAISO cannot share the detailed calculations of the median MMA values. Doing so may result in releasing confidential maintenance cost data. The CAISO recognizes that this is not the optimal solution but it is one driven by confidentiality requirements.

As mentioned above, the MMA values give the CAISO useful information about resource-specific maintenance cost data. However, the CAISO believes that using the MMA values as a way to cross-validate the estimates, rather than as the basis of the estimates themselves, is the most appropriate methodology. We believe this because relying solely on the MMA values may result in circularity. Only resources with costs higher than the default values will negotiate with the CAISO and these negotiated values would then become inputs into the calculation of the default values, resulting in a feedback loop of higher and higher default values. The CAISO's use of external estimates breaks this feedback loop by serving as an independent input into the calculation.

The CAISO presents the proposed default O&M Adders in Table 6. Table 6 also shows the median MMA values for those technologies where the external estimate exceed the median MMA values. For the

[11] The CAISO proposed using an interpolated value using a simple linear regression in the revised straw proposal. The use of median values in this final proposal is a change in methodology from the revised straw proposal.
[12] The CAISO concludes that a sufficient number of MMAs was that the technology type has to have at least 20 resources with negotiated MMAs based on actual costs, rather than PPAs or LTSAs. For multi-stage generators, the CAISO uses only the first configuration or, in the case of CCGTs, the 1X1 configuration for the purposes of this calculation.

technologies where the median value negotiated MMAs exceed the external estimates, the CAISO is not disclosing these values for confidentiality purposes. The far right column shows the proposed default O&M Adder calculated as follows for each technology type:

Default O&M Adder = min (External Estimate VM Costs, Median MMA Value)

Table 6 – Proposed default O&M Adder values

Technology Type	External Estimate VM Costs	Median MMA Values	Default O&M Adders	Units
CCGTs	1.74	-	1.74	$/run-hour per MW
[Frame] CTs	52.13	-	52.13	$/start per MW
Aeroderivative CTs	4.38	-	4.38	$/run-hour per MW
Hydro	1.12	0.65	0.65	$/run-hour per MW

Step 5: Using the default O&M Adder value, calculate a resource-specific O&M Adder

The CAISO proposes to use of the capacity of the resource (*i.e.*, its Pmax) to scale default O&M Adder to be a resource-specific O&M Adder. If the resource is a multi-stage generator (MSG), the CAISO proposes to calculate the resource-specific O&M Adder using the Pmax of each configuration to reflect the additional costs of wear-and-tear of operating of each configuration. The resulting unit-specific adder calculation is proposed as follows:

*Resource-specific O&M Adder = Default O&M Adder * Resource's Pmax*

Or if the resource is a multi-stage generator (MSG):

*Configuration-specific O&M Adder = Default O&M Adder * Configuration's Pmax*

Resource-specific O&M Adder – Example calculations

To help illustrate how the resource-specific Minimum Load and Startup O&M Adders will be calculated, the CAISO includes some examples below:

Non-MSG Example

Table 7 – Non-MSG Example

Parameter	***Value***
Technology Type	Aeroderivative CT
Pmax of resource (MW)	50
Proposed default O&M Adder ($/run-hour per MW)	4.38

Resource-specific Minimum Load O&M Adder = default O&M Adder * Pmax of resource
= $4.38 * 50
= $219/run-hour

MSG Example

Table 8 – MSG Example

Parameter	***Value***
Technology Type	Aeroderivative CT
Pmax of Configuration 1 (MW)	50
Pmax of Configuration 2 (MW)	100
Proposed default O&M adder ($/run-hour per MW)	4.38

Configuration 1

Configuration-specific Minimum Load O&M Adder = default O&M Adder * Pmax of Config 1
= $4.38 * 50
= $219/run-hour

Configuration 2

Configuration-specific Minimum Load O&M Adder = default O&M Adder * Pmax of Config 2
= $4.38 * 50
= $438/run-hour

C) Updated proxy cost formulas

This section clarifies the proposed proxy cost formulas under this initiative. In this case, the primary formulas being proposed for modification are the DEB under the Variable Cost option and the Minimum Load Bid Cap and the Startup Bid Cap under the Proxy Cost option. The CAISO is also proposing updates to the formulas Maximum Registered Minimum Load Costs and Maximum Registered Start-up Costs under the Registered Cost option. Those changes are substantially the same as those proposed for the Proxy Cost option and, as the Registered Cost option is much less commonly used than the Proxy Cost option, the CAISO excludes these for brevity's sake.

Variable Cost Default Energy Bid formula

Current DEB =

*1.10 * [(Incremental Heat Rate/1000 x Fuel Region Price)*

+ VOM adder + GMC adder + (Incremental Heat Rate/1000 x Emission Rate x GHG Allowance Price)] + FMU adder (if eligible) + Variable Energy Opportunity Cost (if eligible)

Proposed Variable Cost DEB =

*1.10 * [(Incremental Heat Rate/1000 x Fuel Region Price)*

+ Energy O&M adder + GMC adder + (Incremental Heat Rate/1000 x Emission Rate x GHG Allowance Price)] + FMU adder (if eligible) + Variable Energy Opportunity Cost (if eligible)

Default Minimum Load Cost Bid formula

Current MLC =

*1.25 * [(Minimum Load Heat Rate/1000 x Pmin x Fuel Region Price)*

+ (VOM adder x Pmin) + (GMC adder x Pmin) + (Pmin x Minimum Load Heat Rate/1000 x Emission Rate x GHG Allowance Price) + Major Maintenance Adder] + Minimum Load Opportunity Cost (if eligible)

Proposed MLC =

*1.25 * [(Minimum Load Heat Rate/1000 x Pmin x Fuel Region Price)*

+ (Energy O&M adder x Pmin) + (GMC adder x Pmin) + (Pmin x Minimum Load Heat Rate/1000 x Emission Rate x GHG Allowance Price) + Minimum Load O&M Adder] + Minimum Load Opportunity Cost (if eligible)

Default Startup Cost Bid formula

Current SUC =

*1.25 *[(Start-Up Fuel x Fuel Region Price) + (Start-Up Energy x*

Electricity Price Index) + (Pmin x Start-Up Time Period x GMC adder / 2) + (Start-Up Fuel x GHG Emission Rate x GHG Allowance Price) + Major Maintenance Adder] + Startup Opportunity Cost (if eligible)

Proposed SUC =

*1.25 *[(Start-Up Fuel x Fuel Region Price) + (Start-Up Energy x*

Electricity Price Index) + (Pmin x Start-Up Time Period x GMC adder / 2) + (Start-Up Fuel x GHG Emission Rate x GHG Allowance Price) + Startup O&M Adder] + Startup Opportunity Cost (if eligible)

D) Implementation details

While it is not customary to discuss implementation details within a final proposal, the CAISO believes that some discussion is warranted based on stakeholder questions throughout the initiative. These issues fall into mainly three categories: 1) how existing negotiated MMA and VOM values will be treated, 2) how the CAISO intends to handle negotiation of the newly proposed O&M Adders prior to and after the implementation of the proposal, and 3) other miscellaneous implementation details.

Treatment of existing negotiated MMA and VOM values

In general, the CAISO proposes to allow participants to grandfather in the negotiated MMA values and VOM adder values upon the implementation of this initiative. Under the proposed framework, the existing MMAs will automatically convert to being Minimum Load and/or Startup O&M Adders keeping the same $/run-hour or $/start values. Similarly, the CAISO proposes to allow participants to grandfather in the existing negotiated VOM adders upon implementation, with the existing negotiated VOM automatically converting to being Energy O&M Adders keeping the same $/MWh values.

Upon implementation, some participants with resources that have grandfathered O&M Adders (*i.e.* legacy MMAs or negotiated VOM adders) may wish to negotiate the O&M Adders under the new cost framework. In such cases, the CAISO proposes to allow only two options: 1) negotiate all O&M Adders as a package[13], terminating the grandfathered O&M Adders or, 2) negotiate only those O&M Adders that the resource requests under the new cost framework and set the remaining O&M Adders to the newly proposed default O&M Adder values. This approach will eliminate the risk of double counting of costs between the "grandfathered" O&M Adders and the new O&M Adders that may arise from the proposed changes to the cost framework and principles.

Table 8 – Proposed implementation approaches

Situation	**Proposal**
Resources with no negotiated MMA	Upon implementation, these resources will be *automatically* assigned a resource-specific Minimum Load or Startup O&M Adders based on their technology group, Pmax, and the default values presented in Table 1.
Resources with a negotiated MMA	Upon implementation, these resources will be allowed to keep their existing MMA values. The CAISO will not automatically switch any resources with a previously negotiated MMA over to the newly proposed default Minimum Load or Startup O&M Adders. Instead, the MMA values will be "converted" to a negotiated Minimum Load and/or Startup O&M Adder. This means that their Minimum Load and/or Startup O&M Adders under the new framework will have the same values as their legacy Minimum Load or Startup MMAs. However, as noted in Attachment L.6 of the BPM for Market Instruments, circumstances may arise that would trigger a review or renegotiation of a legacy MMA. This includes situations such as changing from a non-MSG to an MSG, changes in technology type, change of scheduling coordinators, etc. In such cases, the CAISO has the discretion to terminate the existing negotiated value and negotiations would then take place under the new cost principles. If the participant wishes to use the new default Minimum Load or Startup O&M Adders, they can contact the CAISO to switch over to the new values. The negotiations after that point would be carried out under either of the two options noted above this table.
Resources with a default VOM adder	Upon implementation, these resources will be *automatically* assigned to the default Energy O&M Adder value based on their technology group.
Resources with negotiated VOM adder	Upon implementation, these resources will be allowed to keep their existing negotiated VOM adder values. The CAISO will not automatically switch any resources with a previously negotiated VOM adder over to the newly proposed default Energy O&M Adder. Instead, the VOM values will be "converted" to a negotiated Energy O&M Adder. This means that their

[13] For example, a resource has a legacy negotiated VOM adder but no legacy MMAs. Under this option, if they wish to negotiate a Minimum Load O&M Adder, they would be required to negotiate both the Minimum Load O&M Adder and a new Energy O&M Adder to "replace" the legacy negotiated VOM adder.

	Energy O&M Adder under the new framework will have the same value as their legacy negotiated VOM adder. However, as noted in Section 4.1 of the BPM for Market Instruments, circumstances may arise that would trigger a review or renegotiation of a legacy negotiated VOM adder. This includes situations such as changing from a non-MSG to an MSG, changes in technology type, etc. In such cases, the CAISO has the discretion to terminate the existing negotiated value and negotiations would then take place under the new cost principles. If the participant wishes to use the new default Energy O&M Adder, they can contact the CAISO to switch over to the new value. The negotiations after that point would be carried out under either of the two options noted above this table.

As DMM noted in their comments to the straw proposal, the scheduling coordinators for some resources do not have access to the documentation necessary to apply for negotiated maintenance reference values. Typically, this is because these resources are held under a PPA. In such cases, the resource should use the default values until such a time that the documentation can be provided. If no maintenance cost documentation provided, the resource should use the default O&M adder values or can pursue dispute according to current section 30.4.1.1.4 of the Tariff. If no agreement between the CAISO and the SC can be reached, the Scheduling Coordinator has the right to petition FERC to resolve the dispute as to the sufficiency or accuracy of its information. The need to review appropriate resource-specific maintenance cost documentation arises because the CAISO has a responsibility to ensure the sufficiency and accuracy of the information provided by the SC under our Tariff. One of the factors driving the CAISO to propose default values reflecting Variable Maintenance costs is to handle situations such as this.

If an SC has resources with existing negotiated MMAs or VOM adders that were originally negotiated based on PPA values, the CAISO proposes to allow these values to be grandfathered in. A resource that wishes to increase their negotiated values under the new cost framework can do so once they can provide the appropriate documentation. The CAISO does not wish to discourage SCs from submitting O&M Adder applications. Accordingly, simply just submitting an application for an increase in their grandfathered values will not trigger an automatic switch to the default values.

Negotiations of adders during the time surrounding the implementation this proposal

Under this proposal, CAISO proposes to allow market participants to negotiate any of the O&M Adder values. This process will be analogous to the current process for negotiating MMAs or VOM adders. In order to plan for a potential influx of negotiations requests around the implementation time, this section outlines the CAISO proposed plan.

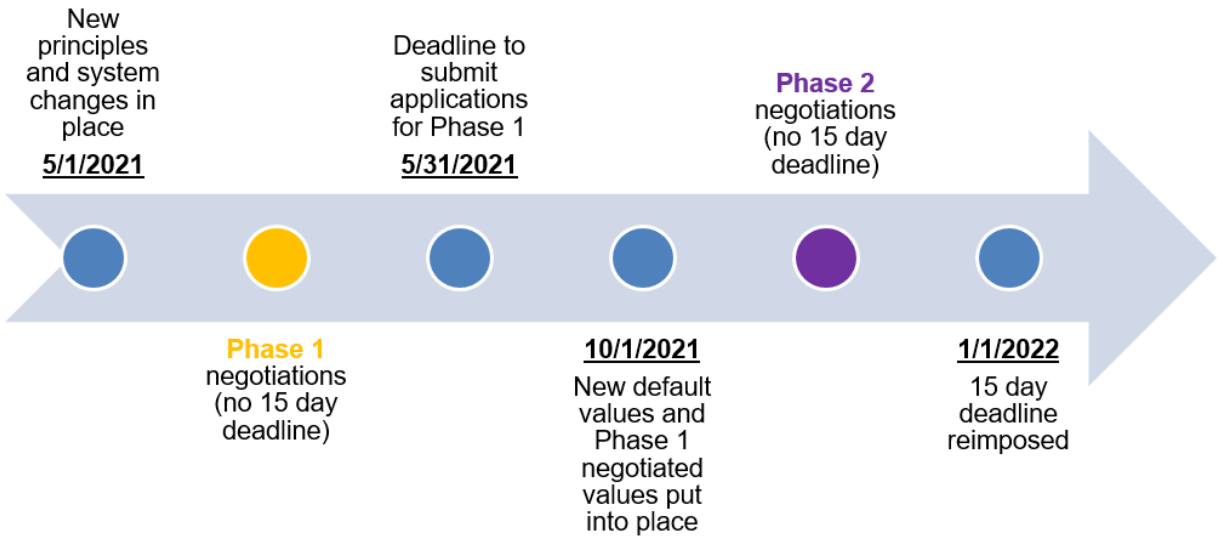
The dates discussed below should be considered only as a reference based on the current and planned schedule.

The proposed implementation plan has two key dates: the date on which the newly proposed O&M principles will go into place and the date on which the new default O&M Adders will be effective. The CAISO expects the explicit principles to be effective on 5/1/2021; this will allow the CAISO and market participants the time to process negotiated O&M Adder values before the next key date. The next key date is 10/1/2021, when the CAISO proposes to implement the new default O&M Adder values.

The CAISO proposes a two-phase approach to handling the negotiations:

> In Phase 1, participants will have a time window between 5/1/2021 and 5/31/2021 to apply for O&M Adders. CAISO will aim at completing their negotiations before 10/1/2021, assuming no major disputes are raised in the negotiation process. Phase 1 is when the CAISO would like most applications to be handled, as this would reduce the pressure on the CAISO and market participants by spreading the negotiations over a multi-month period. These negotiations would be handled on a first-come first-served basis[14]. With the potential for a higher volume of negotiations, CAISO expects to relax the required 15-day period discussed in the "Other miscellaneous implementation details" below during this period.
>
> Phase 2 will apply to applications submitted between 6/1/2021 and 9/30/2021. For applications submitted during this period, the CAISO does not commit to completing the negotiations by 10/1/2021. While the CAISO will do its best to work with market participants to complete negotiations before 10/1/2021, the potentially large number of negotiations may be overly difficult to complete before that date. These negotiations would also be handled on a first-come first-served basis and would not be subject to the 15-day period discussed in the "Other miscellaneous implementation details" below. On 1/1/2022, the 15-day period would be reimposed and negotiations after that date would carry on under normal circumstances.

Figure 4 – Proposed Implementation Timeline



[14] The exception to this would be certain cases that require more immediate negotiations. Examples of these cases are if a resource changes to a new SC or a new resource enters the market. In such cases, the CAISO expects to negotiate these applications on a more expedited basis.

The CAISO expects to provide detailed BPM guidance early in 2021 so that market participants can begin gathering O&M cost data far in advance of 5/1/2021. In this guidance, the CAISO will clarify the expectation for documentation to be provided. Understanding that these negotiations are a two-sided affair and represent an investment of time and resources, the CAISO welcomes comments on this section of the proposal as well.

Other miscellaneous implementation details

Negotiation timelines

The CAISO also proposes to modify the portion of the Tariff that subjects the CAISO to a 15-day *calendar* day period in which the CAISO must review and respond to negotiation applications and questions. This 15-day period is intended to provide market participants with a timely response to their MMA negotiation application. The CAISO proposes to update in which the CAISO must review and respond to O&M Adder applications and questions that the time period be 15 *business* days.

In reaction to this, the CAISO also proposes to change the 30 calendar day period during which market participants cannot renegotiate their O&M Adders after they have been accepted. The CAISO proposes to extend this to a 30 *business* day period.

Triennial review

The CAISO proposes to review the default O&M Adders once every three years to ensure their appropriateness. During these triennial reviews, the CAISO will consider factors such as inflation or changes in technology. The next triennial review is slated for 2021 and the cost year used in this proposal is 2019. Accordingly, the CAISO expects the 2021 triennial review to be a considerably abbreviated review, with an incremental review of the values, but likely not the cost framework, being expected in 2024.

Based on stakeholder comments, the CAISO would also like to note that we do not propose to automatically apply a uniform adjustment factor (e.g. for inflation) to either the default or negotiated O&M Adder values on an annual basis. The negotiated O&M Adder values are negotiated on a number of bases (historical cost information, LTSA/PPA contracts, etc.) and thus applying a uniform adjustment factor might not be appropriate. The default values were derived from source documentation in which assumptions were made about cost inflation or were calculated based on negotiated values, and thus simply applying a uniform adjustment factor also appears inappropriate. The CAISO currently negotiates inflation adjustments for on a resource-specific basis frequently and these negotiations are often simple and brief; we expect that this will continue to be the case for O&M Adders upon the implementation of this initiative.

RMR resources

The CAISO does not intend this initiative to alter the treatment of reliability-must-run (RMR) resources. For new RMR resources, the CAISO claws back MMAs from market revenues in the financial settlement of the RMR Units for the variable costs recovered through the market. This mechanism ensures that

fixed payments made to RMR owners, which include reimbursement for major maintenance costs[15], if applicable, and the revenues earned by RMR owners from the CAISO's markets are not duplicative. RMR resources also recover their minor Variable Maintenance and Variable Operations Costs through the VOM adder that is included in RMR resources' market revenues. This initiative does not propose to alter this treatment and thus we do not expect to modify the pro-forma RMR agreement as a result of this initiative.

E) Default Wind Variable Operations Costs Calculation

Based on stakeholder feedback on the revised straw proposal, the CAISO determined that a sufficient basis exists for the development of default Variable Operations costs for wind resources. These cost estimates are used to calculate the default Energy O&M Adder for wind resources. They represent the CAISO's estimate of variable royalty payments to the owners of the land on which wind turbines are situated. The calculation has two core components: 1) an estimate of the gross revenues received by wind resources, expressed in $/MWh and 2) an estimate of the royalty payments due to landowners, expressed in the percentage of gross revenues.

The CAISO estimates the gross revenues received by wind resources by using 2019 CAISO average 15-minute prices. This estimate, derived from DMM's 2019 Annual Report on Market Issues and Performance, is $37.50/MWh. Because wind resources are not producing at full capacity on a 24/7 basis, we multiply the price by a capacity factor to arrive at gross revenues. Using CAISO/EIM operating data from 2019, the CAISO estimates a capacity factor for wind resources at 25%. This value, $37.50/MWh * 25% = $9.38/MWh, approximates the gross revenues received by wind resources, on average, during the study year 2019.

Once an estimate of the gross revenues received by wind resources has been determined, the CAISO applies a percentage rate to these revenues to estimate the default Variable Operations costs. This percentage represents the variable payments made by wind resource owners to the owners of the land on which wind turbines are situated. Because this cost varies with the MWh production of the resource and is not included elsewhere in the proxy costs (e.g. maintenance costs, greenhouse gas allowance costs, fuel costs, and grid management charges), this is properly considered a VO cost. The CAISO believes that a reasonable percentage to apply is 3%. The CAISO corroborated this percentage using multiple sources, the primary source being from the New York State Energy Research and Development Authority (NYSERDA). The final estimate for Variable Operations costs for wind resources is found by multiplying the gross revenues of $9.38/MWh by 3% to arrive at a value of $0.28/MWh.

We also recognize that not all wind resources face royalty payments and not all royalty payments are made on a variable (*i.e.* percentage of gross revenues) basis. However, the use of the generally accepted 3% benchmark estimate and the relatively low $/MWh value (in comparison to other Variable Operations costs estimates), the CAISO believes that we have a sufficient basis to propose a conservative default Variable Operations cost estimate.

[15] For RMR resources, the major maintenance costs are spelled out explicitly in the RMR contract, meaning that they can be easily identified. This is different than for other non-RMR resources where a distinction between major and minor Variable Maintenance costs are not made.

F) Default Variable Operations Costs Report by Nexant

See the report starting on the following page. No changes were made to Nexant's report since the revised straw proposal, hence some of the language used in Nexant's report may be slightly inconsistent with the language in the remainder of the final proposal. The core goal of the Nexant report is to provide estimates of Variable Operations costs; that has not changed between versions of this paper.

REPORT

Nexant

Reimagine tomorrow.

Variable Operations Costs Report - Version 2

Submitted to: California Independent System Operator

Contents

1 Introduction and Background

1.1 Objectives and Requirements

The CAISO engaged Nexant to assist them to review and update the variable operations and maintenance cost values that are used in their market processes. The CAISO's overall objectives for this engagement are as follows:

1) To perform a review of the variable operations costs (VO) of generators in order to help ensure that the cost inputs used in CAISO markets are reasonable reflections of expected costs.

2) To revise the current technology types and default values for VO in its Tariff to reflect the current technology and technology-specific VO costs in the Western Interconnection.

In addition, listed below are a few other requirements that went into the development of the VO default cost values:

- VO values should be developed for generator types that have a significant market presence in the Western Interconnection
- VO values should adhere to the CAISO's definition of Variable Operations Costs discussed below.
- Since VO values developed will be used by the CAISO as default values in the CAISO market they should be representative of a large fraction of the generators in the class - for generators whose variable operations costs are different the default VO value, the CAISO is expected to continue its past practices of working with generator owners to develop generator-specific VO values.
- To the extent possible, VO values should be developed using publicly available information.
- The VO costs developed should be representative of the costs in the year 2019. To accomplish this, the project included the development of a methodology to escalate cost data from years prior to 2019 (i.e. in 2009 dollars) to cost in 2019 dollars.

On December 26, 2018, Version 1 of this report was completed and made available to stakeholders. It was presented to stakeholders on a conference call on January 8, 2019 and comments on the report were solicited by the CAISO following the call. This report (Version 2) is part of the overall actions that the CAISO has taken in response to these comments and to additional stakeholder comments regarding cost adders received after the January 8, 2019 stakeholder call. The CAISO has developed a summary of their overall approach to operations and maintenance costs/adders which can be found on the CAISO website.

1.2 Report Overview

This report summarizes the work that was performed to the meet objectives while meeting the requirements listed above – namely the review and potential revision of the default VO values used in the CAISO market.

This draft report is organized into the following sections:

- **Section 2:** Cost Definitions, Data Sources and Methodology for Cost Development
- **Section 3:** Cost Information for Generating Plants

2 Cost Definitions, Data Sources and Methodology for Cost Development

2.1 Cost Definitions

We note that in the course of searching for data and developing the various costs factors, there are no standard definitions for what operations and maintenance costs should be considered variable vs. what costs should be considered fixed. Further, there are no standard definitions regarding what costs should be considered variable with respect to energy production (MWh) or plant starts or plant operating hours. This report utilizes the following CAISO definitions (directly or indirectly) in characterizing cost information in this report. They are intended to be consistent with the CAISO's definition related to VO costs as they are designed to be used in the CAISO market processes.

2.1.1 Variable Operations Costs (VO)

Variable Operations (VO) costs are the portion of the operations costs that are a function of the level energy production (MWh) of the generating unit over any period of interest. In other words, the portion of operations costs (excluding fuel costs) that varies directly with the MWh production of the generating unit. To be consistent with how the VO costs are used in the CAISO market, the VO values developed in this report include only costs associated with consumables and waste disposal. The VO values do not include any form of maintenance costs.

All references to VO cost in this report are based upon the CAISO definition unless otherwise stated.

Examples of costs that are included in the VO values per the CAISO definition are costs for:

- Raw water
- Waste and wastewater disposal expenses
- Chemicals, catalysts and gases
- Ammonia for selective catalytic reduction
- Lubricants whose use depends upon energy production
- Consumable materials and supplies

Other cost categories that are often referred to in the industry include major maintenance, other maintenance and fixed operations costs, none of which are included in the VO values in this report.

2.2 Data Sources

2.2.1 General

Generally, public data that could be used to develop O&M values often come from reports that were developed for generation planning or analysis. As such, they are focused heavily on capital costs and the O&M costs are normally treated at a high level. In these sources, O&M cost is not generally segregated into categories that are useful to developing a CAISO VO default value. For developing VO costs that are consistent with the CAISO market design, emphasis was placed upon finding data sources that segregated the costs related to consumables and waste disposal from other costs, making it possible to more accurately estimate VO costs for use in the CAISO market. The various sources referred to in the course of developing the default VO values are listed below.

2.2.2 Independent System Operators' Cost of New Entry (CONE) Study Reports

Independent System Operators (ISOs) that operate capacity markets in the US (e.g. New York ISO, PJM, and ISO New England) periodically perform Cost of New Entry (CONE) studies to develop the demand curve for their capacity auctions. Typically, the ISOs hire an Independent Consultant to develop the inputs for the demand curve, including the cost of a new peaking unit. These studies involve the detailed development of construction cost estimates, operating cost data and plant operating characteristics by an engineering firm or based on inputs from an engineering, procurement and construction (EPC) company. In these studies, the CONE for two types of plants are typically developed – peaking plants which include simple cycle aeroderivative combustion turbines, frame combustion turbines and reciprocating internal combustion engines (RICE) and combined cycle power plants using 1x1 or 2x1 configurations of frame combustion turbines.

In addition to capital costs for new units, the fixed O&M costs and variable O&M costs are also developed in these studies. Typical fixed plant expenses include routine O&M, and administrative and general costs. Variable O&M costs are directly related to plant electrical generation and start-ups and consist of two components. One variable operating cost component includes the consumables such as ammonia for the Selective Catalytic Reduction (SCR), chemicals, and lube oil for the RICEs, water, and other production-related expenses including SCR and oxidation catalyst replacement. This component is similar to the CAISO VO definition. Major maintenance costs (parts and labor) associated with gas turbine, steam turbine, and HRSG are provided as a separate line item in these reports but are not included in the VO values developed in this report.

The CONE reports for NYISO and PJM can be accessed using the links below. NYISO and PJM have performed these CONE studies every three years.

https://www.nyiso.com/installed-capacity-market

(Note: The reports can be accessed by clicking on “Installed Capacity Data”, “Reference Documents” and “2017-2021 Demand Curve Reset”.)

https://www.pjm.com/markets-and-operations/rpm.aspx

(Note: The most recent report can be accessed under “External Reports” on this page. Earlier reports can be obtained by searching for “Brattle CONE report” using the search function on this page.)

2.2.3 Sargent and Lundy

Sargent & Lundy published the “New Coal Fired Power Plant Performance and Cost Estimates report” in August 2009. This one-time report which was produced for the EPA provides a detailed breakdown of the variable O&M components for coal plants in a manner that is consistent with the CAISO VO definition. This disaggregation of O&M costs allows for the calculation of VO associated with consumables and waste only which enables a bottom-up calculation of VO values. This data is used for the many coal fueled power plants in the report as well as a reference to other fossil fueled plants with similar water and emission control systems.

https://www.epa.gov/sites/production/files/2015-08/documents/coalperform.pdf

2.2.4 EPA Compilation of Air Pollutant Emissions Factors (AP-42)

Compilation of Air Pollutant Emissions Factors (AP-42) has been published by EPA since 1972 as the primary compilation of EPA's emission factor information. It contains emissions factors and process information for more than 200 air pollution source categories. A source category is a specific industry sector or group of similar emitting sources. The emissions factors have been developed and compiled from source test data, material balance studies, and engineering estimates. Data from this source was used to compare/develop estimates for consumables related to emission controls for various generation types including coal, natural gas and biomass.

https://www.epa.gov/sites/production/files/2015-07/documents/emission-factors_2014.pdf

2.2.5 DOE Utility-Scale Solar Reports

The DOE Utility-Scale Solar Report, published annually since 2011, provides an overview of developments and trends in the U.S. solar power market. This report summarizes the trends in the solar industry related to installation, technology, performance, cost and solar power purchase agreement (PPA) prices. In addition to capital costs, this report also provides a detailed summary of O&M costs. Berkeley Lab, the primary author of this report, has compiled limited O&M cost data for 40 solar projects in the United States, totaling 800 MW and with commercial operation dates of 2011 through 2016. Although the data sources do not all clearly define what items are included in O&M costs, in most cases the reported values include the costs of wages and materials associated with operating and maintaining the solar project, as well as rent. Other ongoing expenses, including general and administrative expenses, taxes,

property insurance, depreciation, and workers' compensation insurance, are generally not included.

https://emp.lbl.gov/sites/default/files/lbnl_utility_scale_solar_2018_edition_report.pdf

2.2.6 DOE Wind Technologies Market Reports

The DOE Wind Technologies Market Report published annually since 2005 provides an overview of developments and trends in the U.S. wind power market. These reports summarize the trends in the wind industry related to installation, technology, performance, cost, wind power price and policies. In addition to capital costs, this report also provides a detailed summary of O&M costs. Berkeley Lab, the primary author of this report, has compiled limited O&M cost data for 164 installed wind power projects in the United States, totaling 14,146 MW and with commercial operation dates of 1982 through 2016. These data cover facilities owned by both IPPs and utilities, although data since 2004 are exclusively from utility-owned projects and so may not be broadly representative. The treatment of O&M costs for wind projects is similar to the treatment of O&M costs for solar projects as described in the previous section in that data sources do not all clearly define what items are included in O&M costs but generally include or exclude the same type of costs as listed in the previous section.

https://www.energy.gov/sites/prod/files/2018/08/f54/2017_wind_technologies_market_report_8.15.18.v2.pdf

2.2.7 NREL O&M Cost Reports

The National Energy Renewable Laboratory periodically publishes detailed reports on the O&M costs associated with wind and solar PV plants. These reports give a detailed breakdown of the O&M cost components for wind and solar plants and can be used to determine the costs that are variable and fixed as per CAISO's definition.

https://www.nrel.gov/docs/fy08osti/40581.pdf

https://www.nrel.gov/docs/fy17osti/68023.pdf

2.2.8 EIA Annual Energy Outlook Reports

The U.S. Energy Information Authority (EIA) has been publishing the Annual Energy Outlook (AEO) since 1979. Projections for the AEO report are obtained from the North American Energy Modeling System (NEMS), a model developed and maintained by the Office of Energy Analysis of the U.S. EIA. NEMS has several modules of which the Electricity Market Module (EMM) is one. The NEMS Electricity Market Module (EMM) represents the capacity planning, dispatching, and pricing of electricity. Based on fuel prices and electricity demands provided by the other modules of NEMS, the EMM determines the most economical way to supply electricity, within environmental and operational constraints. The cost and performance characteristics of new generating technologies are inputs to the EMM electricity capacity planning submodule. EIA maintains an archive (https://www.eia.gov/outlooks/aeo/archive.php) of assumptions used in the NEMS model. These assumptions are available for the years 1996 and later.

Every three years on average, the EIA commissions an external consultant to update current cost estimates for certain utility scale electric generating plants. The external consultant reports from 2010, 2013, and 2016 are available on EIA's website. The focus of these studies is to gather information on the engineering, procurement and construction costs, operating costs, and performance characteristics for a wide range of generating technologies. Where possible, costs estimates are based on information derived from actual or planned projects known to the consultant.

Non-fuel operations and maintenance (O&M) costs associated with each of the power plant technologies are also evaluated in these external consultant studies. The O&M costs that do not vary significantly with a plant's electricity generation are classified as fixed, while the costs incurred to generate electricity are classified as variable. However, in these reports, all the major maintenance costs are included under variable O&M costs.

EIA scales the costs using a cost adjustment factor for the years that an external consultant's report is not produced. The cost adjustment factor, based on the producer price index for metals and metal products, allows the overnight costs (capital costs) to fall in the future if this index drops, or rise further if it increases. It should be noted that the methodology for calculating the various costs has been consistent only for the past 10 years. Older data, while available should be used with caution since the methodology used for classifying various costs followed a different approach. In addition, the most recent studies are generally high level and do not go into the detailed engineering analysis that one finds in the NY CONE studies or the Sargent and Lundy coal studies discussed above.

2.2.9 Geothermal H_2S Abatement Costs

A paper titled "Geysers Power Plant H_2S Abatement Update" by John Farison, Brian Benn, Brian Berndt, Calpine Corporation; was published in the Geothermal Research Council Transactions, Vol. 34, 2010. The paper deals with hydrogen sulfide treatment at the Geysers Power Plant in northern California including effluent abatement and the operations and maintenance costs associated with the H_2S treatment. A link to the paper is included below. This source was used to develop default VO values for geothermal generating units.

https://www.geothermal-library.org/index.php?mode=pubs&action=view&record=1028816

2.2.10 Black & Veatch

This report (COST AND PERFORMANCE DATA FOR POWER GENERATION TECHNOLOGIES, 2010) was prepared for the National Renewable Energy Laboratory NREL (NREL) for comparison of cost of conventional technologies vs. renewable technologies. NREL contracted Black & Veatch to provide the power generating technology cost and performance estimates that are described in this report. This data was used to compare against other sources of cost for renewable generation plants. Some of the cost data in this report is based upon EIA reports.

https://www.nrel.gov/docs/fy11osti/48595.pdf

2.2.11 Wood Fuels Handbook

Report prepared by Dr. Nike Krajnc and published by the Food and Agriculture Organization of the United Nations (FAO-UN), 2015. This report provides data on various biomass fuels and their detailed analysis. This handbook was used in estimating the Biomass VO cost.

https://roycestreeservice.com/wp-content/uploads/Wood-Fuels-Handbook.pdf

2.2.12 Lazard's Levelized Cost of Energy

Lazard regularly publishes LCOE reports that include capital and O&M costs. However these reports do not provide detailed breakdown of cost components. This source was used as a source of O&M data for nuclear plant O&M costs.

https://www.lazard.com/perspective/levelized-cost-of-energy-2017/

2.2.13 EPA Combined Heat and Power

EPA published a Catalogue of CHP Technologies in partnership with ORNL and ICF in September 2017. It provides O&M cost breakdown for various generation technologies, including IC engines.

https://www.epa.gov/sites/production/files/2015-07/documents/catalog_of_chp_technologies.pdf

2.2.14 Parson Brinkerhoff Report

Parson Brinkerhoff Report for the CCS O&M costs - July 2012 by Parsons Brinkerhoff for IEA Environmental Projects, 2012. This report estimates O&M costs of carbon capture from combined cycle plants. Developed for IEA, it was used to estimate the cost of Carbon Capture and Sequestration costs, if any.

https://ieaghg.org/docs/General_Docs/Reports/2012-08.pdf

2.2.15 IRENA (Renewable Power Generation Cost Reports)

The O&M cost review for some solar, wind, and small and large hydro plants were performed using the IRENA Renewable Power Generation Cost Reports. These reports are published regularly by IRENA and are developed from a cost database that includes 15000 data points for LCOE from projects around the globe, representing over 1000 gigawatts (GW) of power generation capacity. An additional auctions database encompasses over 7,000 projects with nearly 300 GW of capacity. A link to the report is included below.

https://www.irena.org/publications/2018/jan/Renewable-Power-Generation-Costs-in-2017

2.3 Methodology Used to Develop VO Costs

The overall approach taken to develop the VO cost estimates was to first find public sources, if possible, that included VO type information that is consistent with the CAISO's definition of VO costs. When possible this was done with sources that disaggregated VO costs from other types of O&M costs (major and minor maintenance and fixed costs) thus allowing a type of bottom up

estimation methodology. In cases where such data was found, the next steps was to revise the data, if required, to reflect CAISO's requirement of establishing VO default values that are representative of the VO costs that would be applicable to many of the units for this type of generator. As indicated earlier, the expectation is that if there are plants that have VO costs different than the default VO values presented here, that the plant owner/operator can approach the CAISO to develop a unit specific VO value.

It was possible in the case of most generation types to use the approach previously described. In a few cases when a bottom up approach was not possible, VO costs were estimated using aggregated O&M costs that were then partially disaggregated into VO and other costs using engineering judgement.

Finally, these VO costs which represent data for years prior to 2018 were adjusted to be representative of the costs in the year 2019 – the target year for all potential revised VO values. This simple methodology used for escalating a cost from a prior year to 2019 is described below.

2.3.1 Escalating Costs to 2019 Target Year

We reviewed the various cost components in the VO and the range of types of costs in various VO values and observed that these costs can include a range of chemical costs, a range of disposal costs, some labor costs and some disposal fees.

Based upon that review of the components of VO costs and their escalation over time, it was decided that the best, as well as the simplest approach to escalate costs from a previous year (for example, 2016) to the 2019 was to use the US Consumer Price Index (CPI) published periodically by the US Bureau of Labor Statistics (BLS). In this approach, the ratio of the CPI for the two years of interest (i.e., CPI_{2019}/CPI_{2016}) is used to escalate the VO value from 2016 to the year 2019. A link to the CPI used is provided below.

https://www.bls.gov/cpi/tables/detailed-reports/home.htm

2.4 Generators Included in Report

As requested by the CAISO, the types and subtypes of units covered in this report are intended to include those types and subtypes that are representative of the generation technology installed in the Western Interconnect or those that are likely to be installed in the near future. Thus, generating plants that are one of kind or one of a few may not be represented in the report results because they do not meet the "significant market presence" criteria discussed earlier.

3 Cost Information for Generating Plants

The potential Variable Operations Cost default values for all generating plants covered by this report are shown in several tables in this Section 3. The generators have been grouped such that similar generators are listed in the same section and cost table. The information in each grouping includes:

- Name of the Generator Group
- Discussion of the generators in the group
- A brief discussion of the costs included
- A brief discussion of the key sources used to develop the VO value for generators in the group
- A table that list the Generator Types included in the Group and the VO costs in $/MWh in 2019 dollars

Differences between Report Version 1 and 2

The following changes were made to the Version 1 report

- Additional plant types were added to Combustion Turbine and Combined Cycle group to provide for increased granularity to these subgroups. Default values are now provided for both wet and dry tower cooling towers in addition to values for with and without SCR treatment included in Version 1.
- Based upon stakeholder comments, two default values are provided for generators that have a significant market presence in California and the rest of WECC that have a significant portion of their VO cost associated with water usage or an SCR consumable (ammonia). In these cases, one default value is for generators in California and the other for the rest of WECC.
- All references to the variable operations default values used by the CAISO have been changed from VOM to VO to make it clear that the default values do not include maintenance.

3.1 Coal and Natural Gas Generators

Generators in this group include plants that are fueled by coal or natural gas in a variety of configurations. The group includes coal and natural gas-fired subcritical conventional plants.

The variable costs associated with this group of generators includes: 1) water used in water/steam cycle and other processes in the generation facility that utilize water (e.g., coal pile management), 2) chemicals associated with the plant emissions control processes and 3) waste treatment and disposal.

Chemicals that are included for this group (as appropriate to each plant) are:

- Limestone Reagent (dry FGD)
- Activated Carbon (AC) – for mercury control

- Ammonia – for NOx control
- SCR Catalyst Replacement
- Bags for Baghouse
- Other miscellaneous consumables and waste costs

Waste treatment and disposal that are included (as appropriate to each plant) are:

- Bottom Ash Disposal
- Fly Ash Disposal
- Gypsum Disposal
- AC Waste Disposal

In keeping with the aim to develop default VO values, the variable costs for this group of generator types do not include costs for obtaining NOx or SO2 allowances and do not reflect the revenue associated with the sales of waste products.

The primary sources of data used to develop these VO cost estimates included:

- Sargent and Lundy Report
- EPA Compilation of Air Pollutant Emissions Factors (AP-42) - Emissions of criteria pollutants were used to estimate NOx emissions and NOx emission control related consumables for various thermal plants.

Table 3-1: Variable Operations Costs – Coal and Natural Gas Plants (2019$)

Plant Type	V O Cost
Coal Plant - Pulverized Coal – Subcritical	$2.69/MWh
Oil/Gas Steam Plant – Subcritical – In CA	$0.33/MWh

3.2 Combustion Turbine and Combined Cycles Generators

Generators in this grouping include a range of combustion turbine generator types in a both simple and combined cycle arrangements as well as aeroderivative combustion turbines. They include:

- Combined Cycle (CC) Heavy Duty Frame F – This category represents the majority of the existing CCs in WECC. The values were derived based on a 328 MW Siemens 1 x 1 x 1 SGT6-5000F Combined Cycle Power Plant.
- Combustion turbines - F Class - This category represents the majority of the frame gas turbines in WECC. The values were derived based on a 250 MW Siemens SGT6-5000F Simple Cycle Power Plant Cycle Power Plant.
- Combustion turbines (Aeroderivative) – This category represents the majority of the aeroderivative combustion turbines (LM6000 and earlier). The values were derived based on a 51 MW GE LM6000PA Simple Cycle Power Plant.

The variable costs associated with this group of generators includes: 1) water used in water/steam cycle and 2) chemicals associated with the water and plant emission's control processes, and 3) other miscellaneous consumable costs

The primary sources of data used to develop these VO cost estimates included:

- The ISO CONE Reports

Costs are provided for Combined Cycle Plants to capture plants with SCR and wet cooling while CTs are provided with SCR. The ISO intends to use the same values for both the ISO and the rest of the EIM footprint in order to create just one set of default values for each technology type. In converting costs from NYISO to the values used in this report, a multiplier of 1.21 was used for SCR catalyst and ammonia and 1.32 for water.

Table 3-2: Variable Operations Costs – Combustion Turbines and Combined Cycle Plants ($/MWh 2019$)

Plant Type	VO Cost
Combined Cycle CC Heavy Duty Frame F	$0.59/MWh
Combustion Turbines – F Class	$0.97/MWh
Combustion Turbines (Aeroderivative) LM6000	$2.15/MWh

3.3 Nuclear

This group includes existing conventional nuclear plants with ratings of about 1100 MW.

The primary source of data used to develop these VO cost estimates is the EIA reports.

Table 3-3: Variable Operations Costs – Nuclear Plants (2019$)

Plant Type	VO Cost
Nuclear Plant Size 1100 MWs	$1.08/MWh

3.4 Renewable and other Generating Units with VO Costs

The plants in this group are all renewable in nature, except the Internal Combustion Engine generator which are primarily fueled by natural gas. The group includes VO costs of geothermal plants, biomass plants operating on agriculture waste, a land fill gas generation plant and an internal combustion plant. Solar thermal plants have VO costs but the ISO does not intend to propose a default value for these plants and are thus excluded from this report.

Table 3-4: Variable Operations Costs – Renewable Generators with VO (2019$)

Plant Type	VO Cost
Geothermal Power Plant	$1.16 MWh
Biomass Power Plant	$1.65 MWh

Land Fill Gas	$1.21 MWh
Internal Combustion Engine	$1.10 MWh

The primary sources of data used to develop these VO cost estimates included:

- Geothermal H2S Abatement Report
- Sargent and Lundy
- EPA Air Pollutant Emissions Factors (AP-42)
- EIA 2016 Report
- EPA CHP Report

VO costs for these generators will vary based on type or renewable energy and technology. The following is the list of VO components for each type of generating units.

- Geothermal Power Plant – costs associated with H2S removal, and chemicals and water for the steam cycle cooling and other miscellaneous consumables and waste costs.
- Biomass Power Plant – costs associated with water for the steam cycle and for cooling system, ammonia and SCR for NOx control, ash disposal costs and other miscellaneous consumables and waste costs.
- Land Fill Gas – cost associated with NOx control (ammonia and SCR catalyst) and other miscellaneous consumables and waste costs.
- Internal Combustion Engines - cost associated with NOx control (ammonia and SCR catalyst), and other miscellaneous consumables costs.

3.5 Plants without Variable Operations Costs

There are a number of types of generation plants that do not have variable operations and maintenance cost that meet the CAISO definition of VO. That is, they don't have costs that are a function of the level of production (MWhs) that are consumables and waste related. The generation types that are in this category include:

Table 3-5: Generating Plants without Variable Operations Costs

Plant Type
Hydro
Pumped Storage
Solar PV
Wind Generators
Battery Storage Units

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Attachment E

Board Memorandum

Tariff Amendment to Implement Variable Operations and Maintenance Cost Initiative

California Independent System Operator Corporation

March 3, 2021

Memorandum

To: ISO Board of Governors

From: Mark Rothleder, Senior Vice President, Chief Operating Officer

Date: November 11, 2020

Re: **Decision on variable operations and maintenance cost review proposal**

This memorandum requires Board action

EXECUTIVE SUMMARY

As a result of the California Independent System Operator's triennial review and update of variable operations and maintenance (O&M) cost performed in 2018, the ISO determined a more extensive review of the O&M cost framework and principles was necessary. In October 2019, the ISO formalized this stakeholder initiative after discussions with stakeholders about that triennial review and update.

Management's determination that a more extensive review was necessary was based on several issues that exist in the current cost framework and process. Market participants negotiate with the ISO to receive two adders that reflect O&M costs in the ISO markets: the variable operations and maintenance adder and the major maintenance adder. Because there is a lack of publicly available principles for the categorization of O&M costs, these negotiations can become overly complex and burdensome. The triennial review has also become challenging because there are no reference categories for the ISO to evaluate the existing default values. Both of these issues result in greater administrative burden on market participants and on the ISO.

This initiative addresses these issues by proposing to change how O&M costs are estimated and accounted for in the ISO markets via its two components. The first component proposes explicit principles for use in the categorization of O&M costs to be included in the tariff. Having a uniform understanding of these principles will allow for simplified and less onerous negotiations between the ISO and market participants. It also provides reference categories that alleviate the challenge faced by the ISO during the triennial reviews of the default O&M adder values. The second component provides for an updated cost framework on which the updated principles will apply. It also updates the "default" values for O&M adders that can be used by market participants in lieu of negotiations. This new framework estimates a default value for certain O&M costs that currently do not have default values and thus may potentially eliminate the

need for some market participants to engage in negotiations in the first place. These new default values are also more precise than the current values, thereby increasing the efficiency of the market by ensuring that bids into the ISO markets are based on accurate cost estimates. These two components will decrease administrative burden, improve transparency, and lead to a more efficient market.

This initiative falls within the advisory role of the EIM Governing Body and was presented to them during the November 4, 2020 EIM Governing Body meeting. The EIM Governing Body supports this initiative.

Management proposes the following motions:

> ***Moved, that the ISO Board of Governors approves the tariff revisions necessary to implement the variable operations and maintenance cost review proposal items as described in the memorandum dated November 11, 2020; and***
>
> ***Moved, that the ISO Board authorizes Management to make all necessary and appropriate filings with the Federal Energy Regulatory Commission to implement the proposal described in the memorandum, including any filings that implement the overarching initiative policy but contain discrete revisions to incorporate Commission guidance in any initial ruling on the proposed tariff amendment.***

DISCUSSION AND ANALYSIS

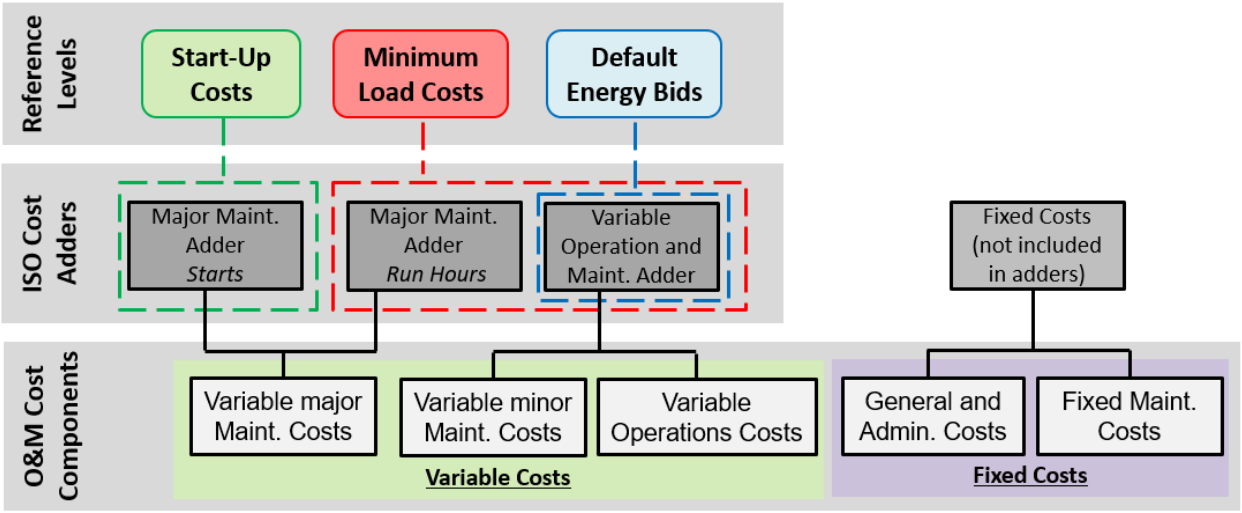
In October 2019, the ISO formalized this stakeholder initiative after discussions with stakeholders about a December 2018 ISO report for updates to the variable O&M costs. That report provided cost estimates to update the default variable operations and maintenance adder values. This cost update is expected to happen triennially. The stakeholder feedback on that report, as well as the insight provided through five working groups held in mid-2019, identified several concerns in the ISO's proposed O&M cost framework. Management formalized this discussion into a stakeholder initiative to provide a mechanism for stakeholders to actively engage in the discussion and allow for tariff updates as needed.

Background on O&M cost frameworks

The current O&M cost framework is shown in Figure 1 below. Both of the current variable operations and maintenance and major maintenance adders allow market participants to include their O&M costs in their bids. The ISO includes these adders in the resource's reference levels: default energy bids and the commitment cost bid caps (a broader term that encompasses the caps for minimum load cost bids and startup cost bids). The reference level for incremental energy costs, known as the default energy bid, is used in local market power mitigation. The reference levels for commitment costs limit what market participants can bid in for minimum load costs and startup costs.

The variable operations and maintenance adder is included in default energy bids under the variable cost methodology and for determining minimum load costs. Currently, the variable operations and maintenance adder includes variable operations and *minor* variable maintenance costs. It has pre-defined default values and can also be set to a custom value via negotiations between the market participant and the ISO. Major maintenance adders are included in minimum load costs and startup costs and include only *major* variable maintenance costs. Major maintenance adders can only be established via negotiations. As further detailed below, this initiative proposes to update this cost framework.

Figure 1 – Current Cost Recovery Framework in ISO Markets



Proposed principles for cost categorization

Management proposes a set of principles for the categorization of variable maintenance costs, variable operations costs, and fixed costs as identified in Figure 1 above.[1] These principles will be used as a reference during negotiations and in the development of default values. These principles seek to balance prescriptiveness, for situations when a clear line must be drawn to guide negotiations, with flexibility, for situations when there is a diversity of practice in the field. Most of Management's efforts and stakeholder feedback have been directed towards the variable maintenance cost principles, as the maintenance of a generating facility is a costly activity that differs significantly across organizations and technologies.

<u>Variable operations costs:</u>

Variable operations costs are the costs of consumables and other costs that vary directly with the electrical production (i.e., the run-hours, electricity output, or the start-up/shut-down) of a generating facility, specifically excluding maintenance costs, greenhouse gas allowance costs, fuel costs, and grid management charges.

[1] The term variable maintenance costs is inclusive of both major and minor variable maintenance costs. Under this initiative, the ISO does not attempt to differentiate between major and minor variable maintenance costs.

Variable maintenance costs:

Variable maintenance costs are the costs associated with the repair, overhaul, replacement, or inspection of a generating facility that adhere to the following conditions:

1) Such costs must vary with the electrical production (i.e. the run-hours, electricity output, or the start-up/shut-down) of the generating facility.
2) Such costs should reflect future maintenance costs that are expected to be incurred within the service life of the major component of plant or equipment.
3) Such costs should be consistent with good utility practice.
4) Such costs should not effect a substantial betterment to the generating facility.
5) If the item is a replacement, it cannot be a replacement of an existing major component of plant or equipment.

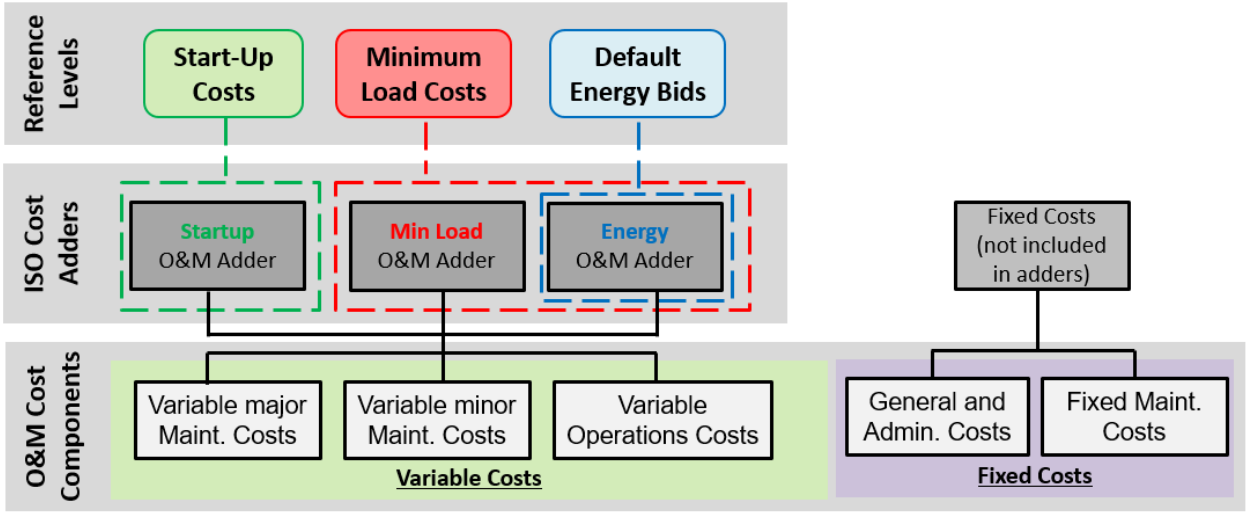
Fixed costs:

Fixed costs include fixed maintenance, general and administrative, and other costs. Fixed maintenance costs are maintenance costs that do not vary with the electrical production (i.e. the run-hours, electricity output, or the start-up/shut-down) of the generating facility. General & administrative costs are non-maintenance costs incurred at a generating facility that do not vary with or relate to production (i.e. the run-hours, electricity output, or the start-up) of the generating facility. Other costs include any other plant-specific costs that are fixed in nature.

Proposed O&M cost framework and default values

The other main component of Management's proposal provides for an enhanced cost framework on which the newly defined principles will apply, and updates the default values used for the O&M adders. Figure 2 presents the proposed update to the O&M cost framework. The main update to the cost framework is that variable maintenance and variable operations costs, rather than being restricted to only certain reference levels, can now be reflected in all three.

Figure 2 – Proposed Recovery Framework in ISO Markets



The final proposal contains the proposed updates to the default O&M adder values, as well as the current values used for the variable operations and maintenance adder and the major maintenance adder.[2] The proposed default values for variable operations costs were derived from a study performed by Nexant on behalf of, and with the guidance of, Management while the proposed default values for variable maintenance costs were developed by the ISO. Direct comparison between the current default values and the new default values is difficult because the grouping of costs and the units of measurement differ between the two. If such a comparison were conducted, the new variable operations costs would appear to be lower than the current variable operations costs. This decrease would be partially offset by an increase in the variable maintenance costs included in the new default values. Any negative impact of the changes in default values can be mitigated by participants by pursuing the negotiated option. The negotiated option allows participants to negotiate the O&M adder values, consistent with the current practice for variable operations and maintenance adders and major maintenance adders.

Some salient features of this proposal include:

- The cost estimation process is publicly verifiable and robust, which Management believes is valuable. A public process provides the transparency and ability to review Management's claim that the resulting default values are just and reasonable. During the development of the default values, we further supported that claim by cross-validating the external cost estimates against an internal set of maintenance cost data developed over 8 years of variable operations and maintenance adder and major maintenance adder negotiations.
- The default values should be generally useful while also sufficiently conservative. Because the cost estimates are used in the calculation of reference levels that

[2] Under the proposal, the "O&M adder" replaces the variable operations and maintenance adder and major maintenance adder, as shown in Figure 2. Management proposes that O&M adders can be comprised of variable operations and variable maintenance costs and can be included in any of the three reference levels.

are ultimately used in local market power mitigation, they must be a conservative estimate to avoid market inefficiencies. However, they must also be set to a level that helps market participants and the ISO minimize the number of negotiations conducted. Management believes that our final methodology successfully balances these two competing goals.

POSITIONS OF THE PARTIES

While stakeholders are broadly supportive of Management's proposal, some raised specific concerns regarding the language for the proposed categorization principles. No stakeholders who provided comments on the draft final proposal generally opposed the initiative.

From a policy perspective, most comments focused on the language of the principles and on the proposed default O&M adder values. During the stakeholder process, Management incorporated stakeholder suggestions into the final language of the principles. For example, Puget Sound Energy (PSE) suggested that the term "substantial betterment" used by FERC in its Uniform System of Accounts was more appropriate in considering the treatment of improvements to equipment. In response, Management incorporated this language into the principles. PSE, while expressing its support for the final principles proposed, noted their concern that certain of the proposed default values are too low compared to their internal cost estimates or grouped in inappropriate technology categories. Management understands PSE's concerns about the default values not being reflective to some specific resource conditions but thinks that the proposed adders are appropriate. They were developed with input from stakeholders, are based on verifiable cost information, and we believe that they strike a reasonable balance between being sufficiently conservative while also being useful for most of participants' resources. Further, under Management's proposal, market participants will still have the ability to negotiate O&M adder values if the default O&M adder values do not meet a specific resource's needs.

From an implementation perspective, stakeholders focused their comments on the treatment of existing O&M adders and on the timeline of the initiative. Several stakeholders note that negotiating their current major maintenance adders and custom variable operations and maintenance adders took time and effort that may go to waste if they are required to renegotiate if Management's proposal is approved. Management incorporated this feedback by proposing to grandfather in the existing major maintenance adders and custom variable operations and maintenance adders under the new proposed cost paradigm. PG&E is concerned that the initiative would be implemented too soon, should the relevant Board and FERC approvals be received. Management believes that PG&E's concerns are valid and we thus updated the target implementation date from October 1, 2021 to January 1, 2022.

The ISO's Department of Market Monitoring (DMM) also generally supports the initiative. This is noteworthy because DMM currently acts as the ISO's agent in these negotiations and thus has accumulated an expertise in the area of O&M costs.

CONCLUSION

Management recommends the Board of Governors approve the variable operations and maintenance cost review proposal. The proposed changes will provide for a more accurate accounting of O&M costs in the ISO markets. This will increase the markets' efficiency by decreasing the administrative burden of negotiations once they are conducted using a defined and common set of principles. The proposal will also decrease administrative burden on the ISO once the triennial cost review is built on a solid, principle-based foundation. If approved, market participants will also have greater flexibility in their ability to reflect their O&M costs in any part of their bids. The newly proposed default O&M adder values were developed through a robust open process, thus providing more transparency. Finally, suppliers may be able to forgo onerous negotiations by relying on pre-determined default values. The efficiency and flexibility added with this proposal will benefit the market as a whole while streamlining the ISO's administrative burden, and should therefore be approved.

Attachment F

Key Stakeholder Dates

Tariff Amendment to Implement Variable Operations and Maintenance Cost Initiative

California Independent System Operator Corporation

March 3, 2021

List of Key Dates in the Stakeholder Process for this Tariff Amendment

Date	Event/Due Date
July 2, 2019	CAISO issues paper entitled "Variable Operations and Maintenance Cost Definitions Report"
July 15, 2019	CAISO hosts stakeholder working group meeting that includes presentation entitled "Variable Operations and Maintenance Cost Review Working Group 1 – Gas Resources"
July 17, 2019	CAISO hosts stakeholder working group meeting that includes presentation entitled "Variable Operations and Maintenance Cost Review Working Group 2 – Storage Resources"
July 19, 2019	CAISO hosts stakeholder working group meeting that includes presentation entitled "Variable Operations and Maintenance Cost Review Working Group 3 – Solar and Wind Resources"
July 19, 2019	CAISO hosts stakeholder working group meeting that includes presentation entitled "Variable Operations and Maintenance Cost Review Working Group 4 – Hydro Resources"
July 23, 2019	CAISO hosts stakeholder working group meeting that includes presentation entitled "Variable Operations and Maintenance Cost Review Working Group 5 – Other Resources"
December 12, 2019	CAISO issues paper entitled "Extenally-Authored Report – Variable Operations and Maintenance Cost"
December 19, 2019	CAISO issues paper entitled "Variable Operations and Maintenance Cost Review – Straw Proposal"
January 6, 2020	CAISO hosts stakeholder conference call that includes discussion of paper issued on December 19 and presentation entitled "Variable Operations and Maintenance Cost Review – Straw Proposal"
January 20, 2020	Due date for written stakeholder comments on paper issued on December 19

Date	Event/Due Date
May 4, 2020	CAISO issues paper (as subsequently updated) entitled "Variable Operations and Maintenance Cost Review – Revised Straw Proposal" and related supporting calculations (as subsequently updated)
May 11, 2020	CAISO hosts stakeholder conference call that includes discussion of materials issued on May 4 and presentation entitled "Variable Operations and Maintenance Cost Review – Revised Straw Proposal"
May 26, 2020	Due date for written stakeholder comments on paper issued on May 4
August 12, 2020	CAISO issues paper entitled "Variable Operations and Maintenance Cost Review – Draft Final Proposal" and related supporting calculations
August 19, 2020	CAISO hosts stakeholder conference call that includes discussion of materials issued on August 12 and presentation entitled "Variable Operations and Maintenance Cost Review – Draft Final Proposal"
September 2, 2020	Due date for written stakeholder comments on paper issued on August 12
October 22, 2020	CAISO issues paper entitled "Variable Operations and Maintenance Cost Review – Final Proposal" and related supporting calculations
October 29, 2020	CAISO hosts stakeholder conference call that includes discussion of materials issued on October 22 and presentation entitled "Variable Operations and Maintenance Cost Review – Final Proposal"
November 3, 2020	CAISO issues draft tariff revisions
November 12, 2020	Due date for written stakeholder comments on paper issued on October 22
November 17, 2020	Due date for written stakeholder comments on draft tariff revisions issued on November 3
November 20, 2020	CAISO hosts stakeholder conference call that includes discussion of draft tariff revisions issued on November 3
January 25, 2021	CAISO issues modified version of draft tariff revisions

Date	Event/Due Date
February 1, 2021	Due date for written stakeholder comments on modified draft tariff revisions issued on January 25
February 2, 2021	CAISO hosts stakeholder conference call that includes discussion of modified draft tariff revisions issued on January 25