



California ISO

Variable Operations and Maintenance Cost Definitions Report

July 2, 2019



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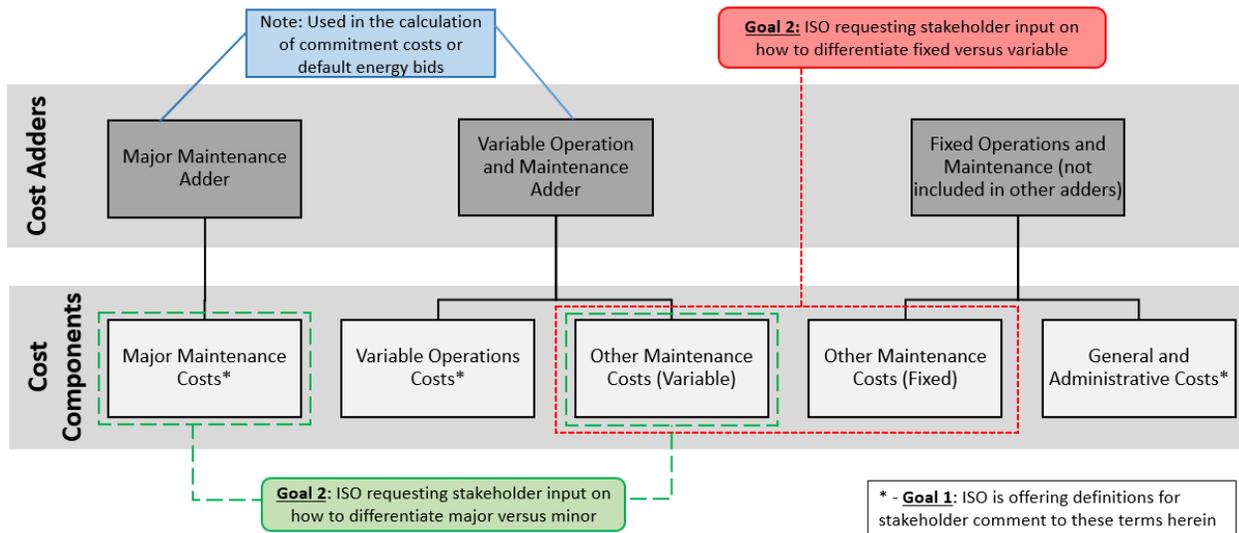
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1) Introduction

The ISO reviews the variable and operations maintenance (VO&M) adders every three years to ensure they are appropriate. The ISO published a report on December 26, 2018 and held a stakeholder call on January 8, 2019 to propose new values to update VO&M adders that are used in minimum load cost and default energy bids. The evaluation of the adders were carried out by Nexant based on CAISO definition and direction of VO&M¹. Several stakeholders commented that there was no formal definition of VOM to support the ISO and Nexant's proposed values. This document was created in partial response to the stakeholder comments submitted during this call and in writing.

Figure 1 below summarizes the goals of this memo: 1) offering definitions for comment for key cost components used in cost adder calculations and 2) highlighting the cost components where the ISO is seeking feedback on how to differentiate the cost components from each other (specifically, how to differentiate fixed versus variable maintenance costs and major versus minor maintenance costs).

Figure 1: Breakdown of Cost Components



The terms listed below are the costs that the ISO will be discussing in this memo:

- General and Administrative (G&A)
- Variable Operations (VO)
- Major Maintenance (MM)
- Other Maintenance (OM)

¹ The report and presentation can be found at <http://www.caiso.com/informed/Pages/StakeholderProcesses/VariableOperations-MaintenanceCostReview.aspx>
www.caiso.com
 MQRCA/MA&F/KH

- Variable Other Maintenance
- Fixed Other Maintenance

General and Administrative expenses are costs incurred at the generator regardless of electrical production (i.e. are “fixed”). Other Maintenance expenses are costs related to the upkeep of a plant which may either be fixed or variable. Variable Operations, Major Maintenance, and the Variable Component of Other Maintenance are costs that directly tied to electrical production (i.e. are “variable”) and, as such, are available for recovery in the ISO markets via default energy bids and commitment costs. The variable component of OM, if any, plus VO comprise Variable Operation and Maintenance (VOM) which is used as a cost adder in the calculation of default energy bids for resources under the Variable Cost Option and for the calculation of minimum load costs.

This paper offers a definition for comment to the various cost components: G&A, VO, and MM. The paper will also consider Other Maintenance costs and discuss the challenges of how to delineate between major and minor maintenance costs, and between fixed versus variable. Based on this discussion, the ISO will organize working groups to solicit stakeholder comments on the completeness and appropriateness of these definitions and any input or evidence on additional cost components.

2) Definition of General & Administrative Costs

General and Administrative costs are those costs incurred at a power plant that *do not vary with and/or relate to production.*

G&A costs include the following:

- Administrative and general costs
- Leasing or rental costs
- Property taxes
- Insurance
- Industry-related fees and costs

The ISO does not include G&A costs in any commitment costs or default energy bids as these costs are incurred routinely and do not depend on electrical production. In other words, these are not short-run marginal costs and thus should not be recovered via the MM or VOM adders. A Tariff-defined term is not necessary since G&A is not recoverable as a marginal component to electrical production in the ISO’s day-ahead and real-time markets.

3) Definition of Variable Operations Costs

Variable Operations costs are the non-fuel portion of the operating costs that are clearly a function of the level energy production (MWh) of the generating unit (as opposed to being a function of calendar time elapsed or of run-hours/startups). In other words, *costs of consumables (excluding fuel costs) that vary directly with the MWh production of the generating unit*. Note that this does not replace VOM but is rather a component of VOM as discussed above. VO costs are expressed in \$/MWh.

VO costs include the following:

- Raw water
- Waste and wastewater disposal expenses
- Lubricants that depends on energy production
- Chemicals such as ammonia, SCR catalyst and CO oxidation catalyst
- Other consumable materials and supplies

A VO cost definition for comments is:

“costs of consumables associated directly with the electrical production of a generating unit and specifically exclude both maintenance and fuel costs.”

4) Definition of Major Maintenance Costs

Since 2012, the ISO has offered the opportunity to establish MM cost adders to allow Scheduling Coordinators the opportunity to recover the costs related to major maintenance that are incurred as a function of a generators' run hours or starts. Attachment L of the Market Instruments BPM contains details on the Major Maintenance Adder (MMA) process. *MMAs capture large-scale maintenance costs that are incurred irregularly and require an extensive outage to complete* but are necessary to maintain the generator in an efficient and reliable condition.

As described in Attachment L, Major Maintenance costs can be directly correlated with starting a generator or running a generator for a period of time. Depending upon how maintenance is performed, the marginal cost components associated with major maintenance may be appropriately quantified in a \$ per run-hour and/or a \$ per start adder. These adders are used in the calculation of commitment costs.

Based on current expectations, a proposed definition of Major Maintenance is:

“costs associated with extensive maintenance of the prime mover of a generating unit that cannot be done as part of routine maintenance. Major maintenance costs must be

associated with electrical production of the generating unit such that the costs can be related to run-hour production or startup of the generating unit.”

5) Other Maintenance Costs

Other Maintenance costs are maintenance costs which do not require the generator to undergo an extensive outage and may be characterized as fixed or variable. Determining whether these costs are fixed or variable, and major or minor is challenging for a few reasons:

- Operations and maintenance (O&M) agreements signed with external vendors are often fixed in dollar values but the underlying activities may indeed vary with electrical production. What may appear to be fixed from a dollar-value perspective could indeed vary based on how many MWhs are generated at the plant due to increased wear-and-tear, heat damage, etc. O&M agreements may also cover major maintenance activities, further complicating separation and classification between major and minor items.
- If all non-major maintenance costs were to halt, electrical production would eventually fall to zero. Accordingly, these costs are somewhat correlated to electrical production. The relatively low cost of minor maintenance and its routine nature make minor maintenance difficult to directly link to electrical production.
- Related to this, the period under consideration is important in delineating fixed versus variable. All costs are variable in the long-run but in the CAISO markets, which are spot and energy-based markets, market participants should only be compensated for their short-run marginal costs. How should the ISO define “short-run?” Defining short-run in the context of maintenance and operations as a typical plant’s construction period (say 5-15 years) is clearly too long. A year seems arbitrary and perhaps too long while the horizons of the markets (a day for day-ahead, fractions of an hour in the real-time market) seems too short.

6) Maintenance Activities

The ISO recognizes a number of maintenance activities take place at market participant’s facilities. These activities may be categorized as major versus minor and fixed versus variable, which would impact their treatment under the Tariff. A partial list of cost items to be considered is included in Appendix 1; this list may not be exhaustive but is the most extensive list of items the ISO could compile through different sources ².

² Some of these of activities were obtained from the original sources used in the December proposal for VO&M listed in the Nexant work. Other sources include the New York Independent System Operator’s Reference Level Manual issued in January 2019 and the FERC System of Accounts, and the Docket No. ER19-210-001, et al., issued www.caiso.com

This extensive yet non-exhaustive list reflects the challenges behind categorizing maintenance activities in a vacuum by the ISO only. Based on these challenges, the ISO is scheduling calls with working groups as described in Section 7 to gain more understanding from stakeholders and solicit stakeholder feedback to help better understand the intricacies of costs incurred when operating different types of plants. Specifically, the ISO would like to understand the nature, frequency, timing, and magnitude of maintenance actions that are required by each type of resource. With this improved and more comprehensive knowledge base, the ISO will work to categorize the above costs as fixed or variable and as major or minor, and subsequently determine estimates for VO&M that can be used as adders in the resources' costs.

7) Next Steps

The ISO will create working groups to discuss these cost categories and definitions as per below. Teleconference dates/times for each group are as follows:

- **July 15, 4-5PM, Working Group 1 – Gas Resources:**
 - Includes Combined Cycle, Steam, Combustion Turbine, and Reciprocating Engine
- **July 17, 10-11AM, Working Group 2 – Storage Resources:**
 - Includes Non-Generator Resources (such as batteries) and fuel cells
- **July 19, 10-11AM, Working Group 3 – Solar and Wind Resources**
- **July 19, 2-3PM, Working Group 4 – Hydro Resources:**
 - Includes Traditional Hydro and Pumped-Storage Hydro Units
- **July 23, 1-2PM, Working Group 5 – Other Resources:**
 - Includes Nuclear, Coal, Geothermal, Landfill Gas, Biomass, and any others



Appendix 1:

General and/or Natural Gas Fired-Related Items	
Inspections, Repairs and Overhauls, and Replacements:	
1) Air Heater/Pre-Heater	27) Generator Field Rewinds
2) Alignment Checks	28) Heat Transfers
3) Battery System	29) High Energy Piping
4) Bearings	30) Hot Gas Paths
5) Boilers, Burners, and Related Items	31) Hot Sections
6) Borescopes	32) Hotwell and Related Items
7) Casings, Shells, and Frames/Diffusers	33) Instrument and Service Air and Water Supply Systems
8) Combustion Turbine Generator Evaporative Cooling System Media	34) Main Steam Piping
9) Combustion Turbines and Related Items	35) Nozzle Block
10) Compressor, Generator, and/or Turbine Rotors	36) Oil Changes
11) Condensers and Evaporators	37) Oxygen Boiler
12) Communication Systems	38) Plant Electrical Systems
13) Compressor Blades	39) Pumps & Motors
14) Compressor Wash System	40) Radial and Axial Clearance Checks
15) Condensate Systems	41) Seals
16) Clutches and Gears	42) Steam Drum and Related Items
17) Cooling Tower Equipment	43) Tubes and Piping
18) Demineralization Systems	44) Transformer
19) Device Calibrations	45) Turbine Blades and Diaphragms
20) Distributed Control Systems	46) Turbine Lube Oil Sampling
21) Duct Burner and Liners	47) Turning and Ratchet Gear Maintenance
22) Emissions Control Equipment Repairs	48) Valves
23) Emissions Monitoring Tests	49) Vibration Analysis Monitoring
24) Filters	50) Water Circuits
25) Fuel Metering Equipment	51) Waterbox
26) Fuel Treatment System	

Cleaning	
52) Chemical Cleaning	56) Hydro-Blast Cleaning
53) Heat Transfer Cleaning	57) Relay Cleaning



Testing	
58) Hydrogen Embrittlement Testing	60) Performance Testing (Oxygen Boiler Tests, On-Line Testing, Pre-Air Heater Test)
59) Non-Destructive Testing	61) Relay & Interlock Testing

Other	
62) Balance-of-Plant	63) Distributed Control System Upkeep

Materials	
64) Instruments	66) Shop Supplies
65) Safety Equipment	67) Tools

Hydro Specific Items	
Inspections, Repairs and Overhauls, and Replacements:	
68) Exciter Water Wheels and Turbines	71) Lubricating Systems
69) Generator Cooling System	72) Main Penstock Valves and Appurtenances
70) Generators	73) Main Turbines and Water Wheels

Coal-Specific Items	
Inspections, Repairs and Overhauls, and Replacements:	
74) Ash Handling Equipment	82) Coal Freeze
75) Ash Hopper	83) Coal-Handling and Distribution Equipment
76) Boiler Condition Assessment	84) Deaerator
77) Coal Bunker	85) Evaporator Tubing
78) Coal Burner	86) Fire Extinguishing Equipment
79) Coal Crusher	87) Precipitator/Bag House
80) Coal Drying	88) Stack, Fans, and Draft
81) Coal Feeder Pulverizing Equipment	89) Superheater/ Reheater/ Economizer Tubing and Headers



Revision History

Date	Version	Description	Author
6/28/2018	1.0	Initial Version	Kevin Head