



California ISO

# Variable Operations and Maintenance Cost Review

*Working Group 1 – Gas Resources*

*Presenters: Kevin Head, Jennie Sage, Sruthi Harihan*

July 15, 2019

## Purpose of Working Groups

- Goal 1: Offer definitions for comment for:
  - Major Maintenance Costs
  - Variable Operations Costs
  - General and Administrative Costs
- Goal 2: Seek stakeholder feedback on how to differentiate cost components from one another on a technology-specific level

**Both goals will aid in the CAISO's updates to Variable Operations and Maintenance cost adder values and may result in addition of new definitions in the CAISO Tariff or BPM**

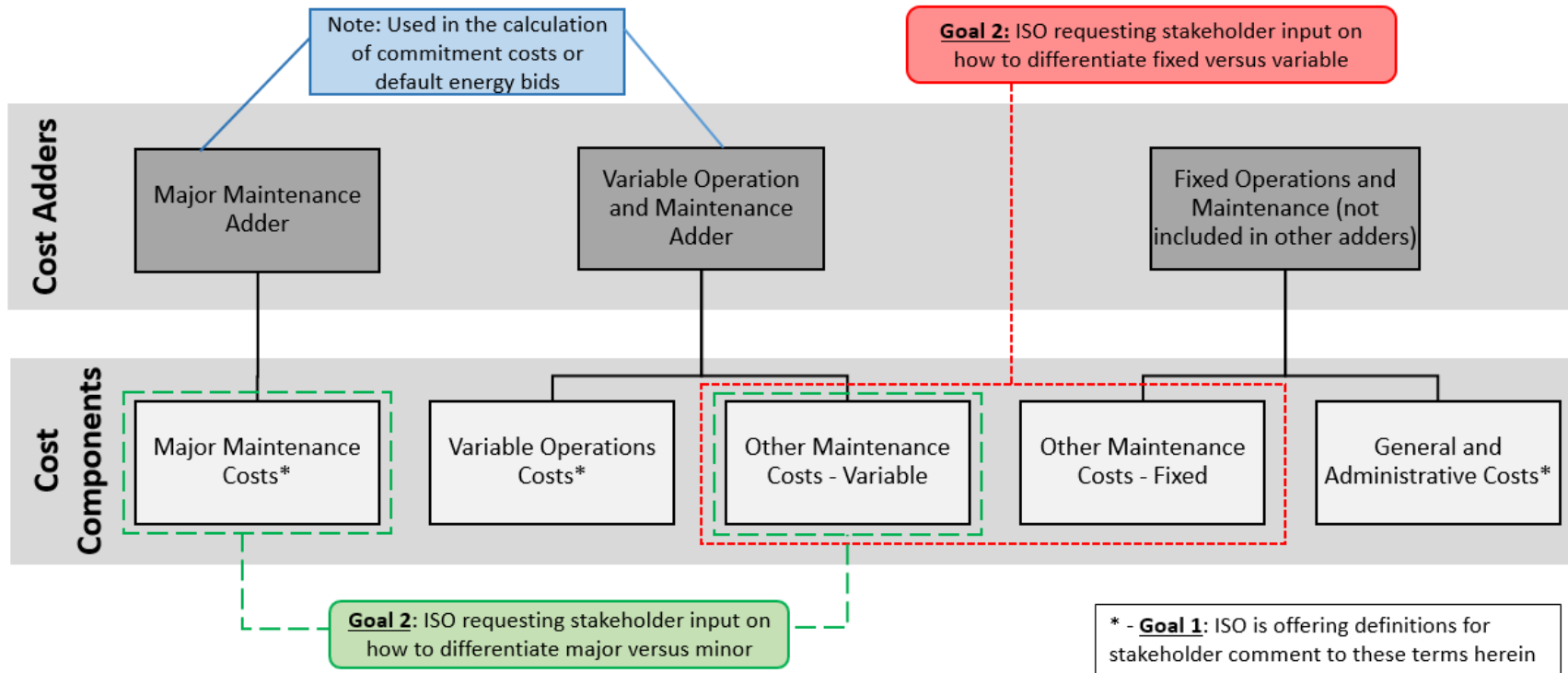
## Background

- The CAISO has committed to revisit Variable O&M (VOM) adder values once every three years
- In December 2018, the CAISO and Nexant published a report proposing updates to VOM adder values that had been in place since 2012
- Stakeholders noted a lack of definitions for major maintenance and variable operations and maintenance in the CAISO Tariff and other issues with the values

# Cost Components

- To aid in the discussion of the gray areas in the process of differentiating costs, CAISO is introducing some new cost component terms:
  - General and Administrative (G&A)
  - Variable Operations (VO)
  - Major Maintenance (MM)
  - Other Maintenance (OM)
    - Other Maintenance - Variable
    - Other Maintenance - Fixed

# Cost Components and Cost Adders



# The Low-Hanging Fruit

## 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.*
- These costs include:
  - Leasing or rental costs
  - Property taxes
  - Insurance
  - Industry-related fees and costs

# The Low-Hanging Fruit

## Variable Operations Costs

- Costs of consumables *associated directly with the electrical production* of a generating unit and *specifically exclude both maintenance and fuel costs.*
- These costs include:
  - Raw water, particularly water used in the steam cycle
  - Waste and wastewater disposal expenses
  - Lubricants that depend on energy production
  - Chemicals used in plant emissions control processes such as ammonia, SCR catalyst and CO oxidation catalyst
  - Other consumable materials and supplies

## Major Maintenance Costs

- 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 the startup* of the generating unit.
- Major maintenance is an existing concept in the CAISO Tariff and an adder already exists for these costs

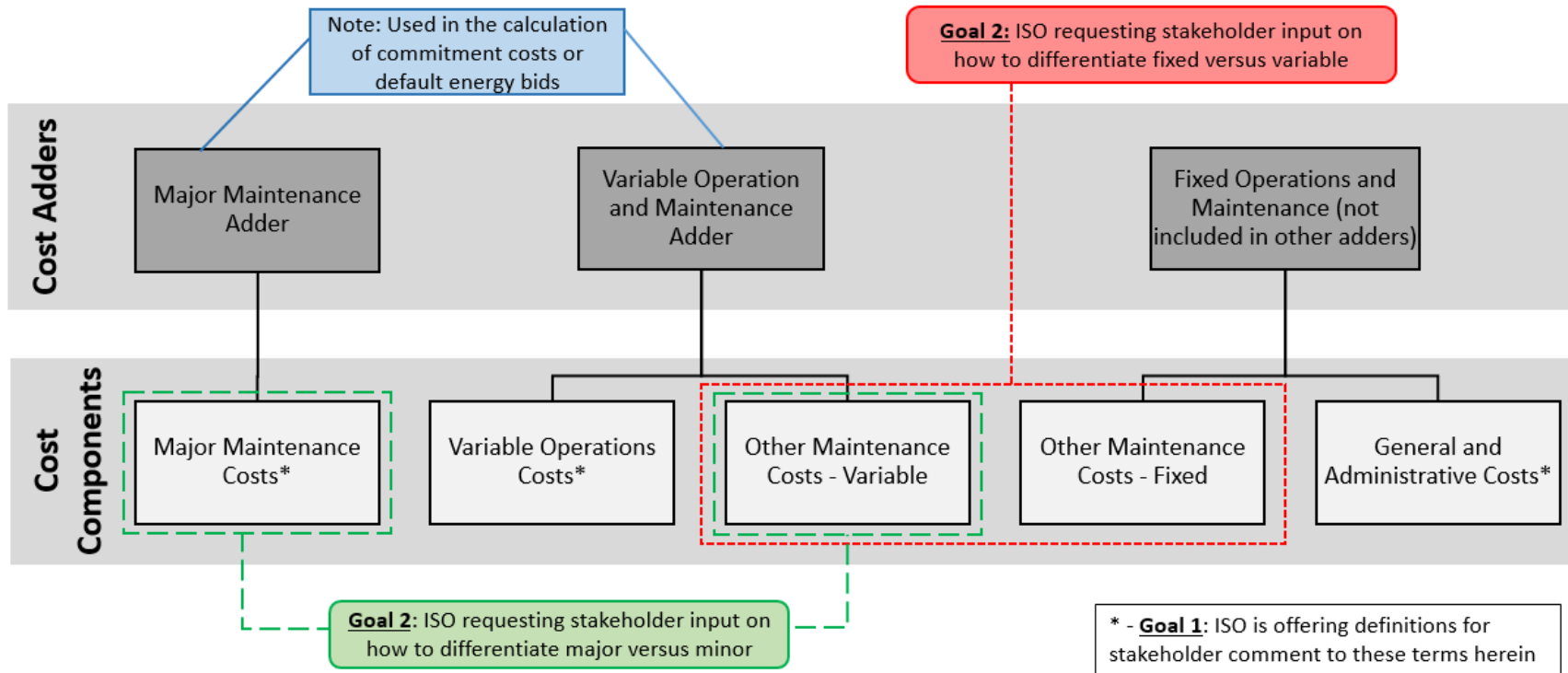


# The Tricky Part

## 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*.
- Challenges:
  - Long-term Service and Power Purchase Agreements
    - Fixed \$-values  $\neq$  Fixed underlying activities
  - All costs are variable in the long-run
  - How to define “short-run”

# Cost Components and Cost Adders



# Previous VOM Adder Values

## Currently used in CAISO markets

Generation Technology	Recommended VOM Cost Adder (\$/MWh)
Combined Cycle and Steam	\$2.80
Combustion Turbine & Reciprocating Engine	\$4.80

## Proposed in December 2018

Plant Type	Variable O&M Cost w/o SCR	Variable O&M Cost SCR
Combined Cycle CC Heavy Duty Frame F	\$0.17 MWh	\$0.26 MWh
Combined Cycle Heavy Duty Frame H	\$0.17 MWh	\$0.38 MWh
Advanced Combined Cycle with Carbon Capture and Sequestration		\$2.64 MWh
Combustion Turbines - E Class	\$0.47 MWh	\$1.58 MWh
Combustion Turbines - F Class	\$0.29 MWh	\$0.82 MWh
Combustion Turbines - H Class	\$0.29 MWh	\$0.82 MWh
Combustion turbines (Aeroderivative) LM6000	\$0.70 MWh	\$1.88 MWh
Combustion turbines (Aeroderivative) LMS100	\$0.72 MWh	\$1.82 MWh
Integrated Coal Gasification Combined-Cycle (IGCC)	\$1.57 MWh	
Oil/Gas Steam Plant – Subcritical	\$0.32 MWh	

# Maintenance Costs - Discussion

<b>Inspections, Repairs and Overhauls, and Replacements:</b>	
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	

<b>Cleaning</b>	
52) Chemical Cleaning	56) Hydro-Blast Cleaning
53) Heat Transfer Cleaning	57) Relay Cleaning
<b>Testing</b>	
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
<b>Other</b>	
62) Balance-of-Plant	63) Distributed Control System Upkeep
<b>Materials</b>	
64) Instruments	66) Shop Supplies
65) Safety Equipment	67) Tools



# Maintenance Costs – Example Proposal

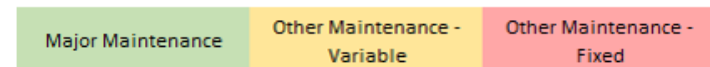
Inspections, Repairs and Overhauls, and Replacements:	
1) Air Heater/Pre-Heater	27) Generator Field Rewinds
2) Alignment Checks	28) Heat Transfers
3) Battery System	29) High Energy Piping
4) Bearings	30) Hot Gas Paths
5) Boilers, Burners, and Related Items	31) Hot Sections
6) Borescopes	32) Hotwell and 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) Boiler Cleaning	56) Hydro-Blast Cleaning
53) Chemical Cleaning	57) Relay Cleaning
54) Heat Transfer 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



## Proposed Next Steps

After today's discussion, we'd like stakeholders to reflect on what was discussed and submit in writing:

- In which cost component the maintenance activities discussed should belong
- Maintenance activities missing that should be included in the future
- Proposals for updates to definitions
- Proposals for categories/sub-categories of generation technologies for VOM adders
- Feedback on structure of this stakeholder initiative and working groups

Send emails to [initiativecomments@caiso.com](mailto:initiativecomments@caiso.com) by 7/26

*Please note if you'd like your comments to be confidential*