

**BEFORE THE WASHINGTON  
UTILITIES AND TRANSPORTATION COMMISSION**

**WASHINGTON UTILITIES AND  
TRANSPORTATION COMMISSION,**

**Complainant,**

**v.**

**PUGET SOUND ENERGY,**

**Respondent.**

**DOCKETS UE-170033 and  
UG-170034 (*Consolidated*)**

**EXHIBIT TO  
TESTIMONY OF**

**David C. Gomez**

**STAFF OF  
WASHINGTON UTILITIES AND  
TRANSPORTATION COMMISSION**

***PSE's Response to Staff DR No. 177, Attachment C, CAISO Business Practice Manual for  
Market Instruments, Version 44 (April 6, 2017)***

**June 30, 2017**

# Business Practice Manual for Market Instruments

Version 39

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## 4. Bid Requirements

Welcome to the *Bid Requirements* section of the CAISO *BPM for Market Instruments*. In this section you will find the following information:

A list of the Bid components that are constant across a Trading Day

A list of the Bid components that can change hourly

A table describing the bidding limitations for Non-Generator Resources (NGRs)

Day-Ahead Bids and Self-Schedules include information on each of the 24 Trading Hours in the Trading Day. Some Bid components are constant for the Trading Day, while other components can vary from hour to hour. Exhibit 4-1 shows which Bid components are constant across the Trading Day – referred to in the exhibit as Daily Requirements – and those that can change hourly – Hourly Requirements.

### 4.1 Daily & Hourly Bid Components

This section is based on CAISO Tariff Section 30.4 Election for Start-Up and Minimum Load Costs and Section 39.6.1.6. (Start-Up and Minimum Load Costs are not applicable to Virtual Bids).

Bid components are divided into two categories:

**Daily Bid components** – These Bid components are constant across all Trading Hours in a Trading Day and do not change for that Trading Day.

**Hourly Bid components** – These Bid components can vary in each Trading Hour of the Trading Day.

With the exception of three Bid components (Start-Up, Minimum Load and Transition Costs), all Bid components can vary each day, and are submitted by SCs as part of their DAM and RTM Bids. For Start-Up and Minimum Load Bid components, the SC selects one of two alternatives: Registered Cost or Proxy Cost. The elections are independent; that is, a Scheduling Coordinator electing either the Proxy Cost option or Registered Cost option for Start-Up Costs may make a different election for Minimum Load Costs. The Start-Up and Minimum Load Bid components are constant for each Trading Day for the period submitted.

If Registered Cost is selected for Start-Up and/ or Minimum Load, the SC submits information for Start-Up and/ or Minimum Load respectively to CAISO for entry into the Master File. Subject to the applicable cap, these values can be updated every 30 days through the Master File Update process that is described in Attachment B. Start-Up and Minimum Load Costs under the Registered Cost Option may not exceed 150 percent of the unit's Projected Proxy Cost for Start-Up and Minimum Load Costs. If the SC selects the Registered Cost Option, the values will be fixed for 30 days unless the resources costs, as calculated pursuant to the Proxy Cost option, exceed the Registered Cost option, in which case the SC may switch to the Proxy Cost option for the balance of the 30 day period. (see Attachment G for details).

If the Proxy Cost option is selected, the Start-Up and Minimum Load Bid components are calculated daily for each Generating Unit based on the daily gas price and includes, in addition, auxiliary power costs (for Start-Up), O&M costs (Minimum Load adder as listed in Exhibit 4-2, the adder is a value registered in the Master File), greenhouse gas allowance Start-Up and Minimum Load costs if applicable (see Attachment K), the Market Services Charge and System Operations Charge components of the Grid Management Charge (GMC) (for Start-Up), the Market Services Charge and System Operations Charge components of the GMC and the Bid Segment Fee component (for Minimum Load), and a major maintenance cost adder if applicable (see Attachment L), which may be different for Start-Up and Minimum Load. The process that CAISO uses to calculate the daily gas price is shown in Attachment C, and there is an example in section 8.2.1.3 for a Generated Bid. The SC is also allowed to submit a Start-Up and/or Minimum Load Cost Bid as part of a generator's Bid in the Day-Ahead Market (DAM) as long as the SC elected the Proxy Cost option for them and the submitted Bid is not negative and is less than or equal to the proxy cost calculated using the daily Gas Price Index.

Transition Cost will be calculated as the product of the Transition Fuel and the Daily Gas Price Index associated with the resource. This will be the same for all Multi-Stage Generating Resources regardless of the resource's elected Cost option.

The details of the Bid components are described in subsequent sections.

**Exhibit 4-1: Daily & Hourly Bid Components**

	Daily Components	Hourly Components	Submitted through SIBR	Comment
Start-Up	✓		<b>Yes, only if proxy cost option is currently effective for Start-Up Cost in</b>	If the resource has elected to use <u>Registered Cost</u> , the Start-Up cost used is that registered in the Master File. If the

	Daily Components	Hourly Components	Submitted through SIBR	Comment
			<b>Master File.</b>	resource has elected the <u>Proxy Cost</u> option, the SC can submit a Start-Up Cost through SIBR. SIBR would use the submitted Start-up cost if it is not negative and is less than or equal to the Start-Up Cost calculated based on daily gas prices.
Minimum Load	✓		<b>Yes, only if Proxy Cost option is currently effective for Minimum Load Cost in Master File.</b>	If the resource has elected to use <u>Registered Cost</u> , the Minimum Load cost used is that registered in the Master File. If the resource has elected the <u>Proxy Cost</u> option, the SC can submit a Minimum Load Cost through SIBR. SIBR would use the submitted Minimum Load Cost if it is not negative and is less than or equal to the Minimum Load is calculated based on gas daily prices.
Transition Costs	✓		<b>No, these values are calculated as defined in Attachment H, based on the calculated start-up costs for each configuration</b>	For a Multi-Stage Generating Resources, the dollar cost per feasible transition associated with moving from one online configuration to another. The calculation is the same for all MSG regardless of the Cost option.
Energy Bid Curve		✓	✓	
Self-Schedule		✓	✓	
Ancillary Services				Bid cannot contain more than certified quantities for each

	Daily Components	Hourly Components	Submitted through SIBR	Comment
				service.
Regulation Down		✓	✓	
Regulation Up		✓	✓	
Spinning Reserve		✓	✓	
Non-Spinning Reserve		✓	✓	
Ramp Rate	✓		✓	Bid by SC, within limits of the minimum and maximum Ramp Rates in the Master File.
Operational Ramp Rate	✓		✓	
Operating Reserve Ramp Rate	✓		✓	
Regulation Ramp Rate	✓		✓	
Contingency Dispatch Indicator	✓		✓	Must be selected if any AS is part of the Bid/Schedule.
Intertie Minimum Hourly Block (DA)		✓	✓	For Non-Dynamic System Resources, specifies minimum number of hours that an intertie bid must be awarded in the DA market, if economic. If no Minimum Hourly Block is set, it defaults to 1.
Dispatch Option		✓	✓	A Bid option that determines the participation of an Intertie resource in the Real-Time Market: <ul style="list-style-type: none"> <li>• Hourly: submission of a HASP Block Intertie Schedules</li> <li>• Once: submission</li> </ul>

	Daily Components	Hourly Components	Submitted through SIBR	Comment
				<p>of an Economic Hourly Block Bid with Intra-Hour option.</p> <ul style="list-style-type: none"> <li>15min: dispatched in each 15 minute Interval of a Trading Hour with a flat Dispatch for all 5 minute Dispatch Intervals of that 15 minute Interval.</li> </ul> <p>Dynamic: dispatched in each 5 minute Dispatch Interval of a Trading Hour.</p>
Pump Shut-Down Cost		✓	✓	
Pumping Cost		✓	✓	
Energy Limit (Maximum and Minimum Daily)	✓		✓	
RUC		✓	✓	
Capacity Limit		✓	✓	<p>(Unrelated to Capacity Limit Indicator). Specifies an upward limit on the total Energy and Ancillary Services awards for a given hour. Limit must be set no lower than the maximum of the highest energy bid or the RA obligation amount.</p> <p>Used mainly for partial RA or non-RA resources who want to limit the total award when bidding multiple services.</p>

	Daily Components	Hourly Components	Submitted through SIBR	Comment
Distribution Factors		✓	✓	These apply to Generating Units only. Generation Distribution Factors are provided on a per-unit basis. SC may submit through SIBR. If none are provided through SIBR, CAISO will use Generation Distribution Factors (GDF) from the GDF Library based on historical generation pattern.
VER Forecast		✓	✓	If a Variable Energy Resource (VER) chooses to supply an energy forecast, the forecast shall be submitted through SIBR. Forecast is submitted for a configurable rolling time horizon as often as every 5 minutes.

**Exhibit 4-2: Default O&M Cost Adders effective April 1, 2012 (\$/MWh)**

Generation Technology	Recommended VOM Cost Adder (\$/MWh)
Solar	\$0.00
Nuclear	\$1.00
Coal	\$2.00
Wind	\$2.00
Hydro	\$2.50
Combined Cycle and Steam	\$2.80
Geothermal	\$3.00

Generation Technology	Recommended VOM Cost Adder (\$/MWh)
Landfill Gas	\$4.00
Combustion Turbine & Reciprocating Engine	\$4.80
Biomass	\$5.00

#### 4.1.1 Bidding limitations for NGRs

NGRs are resources that operate as either Generation or Load and that can be dispatched to any operating level within their entire capacity range but are also constrained by a MWh limit to (1) generate Energy, (2) curtail the consumption of Energy in the case of demand response, or (3) consume Energy.

More generally, NGRs are resources that have a continuous operating range from a negative to a positive power injection; i.e., these resources can operate continuously by either consuming energy or providing energy, and can seamlessly switch between generating and consuming electrical energy. An NGR functions like a generation resource and can provide energy and AS services. Because of the continuous operating range, NGRs do not have minimum load operating points, state configurations, forbidden operating regions, or offline status (unless on outage). Therefore, they do not have startup, shutdown, minimum load, or transition costs.

The regulation energy management (REM) option allows non-generator resources that require an offset of energy in the real time market to provide regulation. NGRs that select this option can only participate in the ISO's regulation markets.

The following table describes the special bidding limitations for NGR's.

**Exhibit 4-3: Bidding limitations for NGRs**

Bid component	Allowed for non REM?	Allowed for REM?	Comment
Start-Up	No	No	By nature NGRs do not have startup costs.

Bid component	Allowed for non REM?	Allowed for REM?	Comment
Minimum Load	No	No	By nature NGRs do not have minimum load costs.
Transition Costs	No	No	By nature NGRs do not have transition costs.
Energy Bid Curve	Yes	No	NGRs selecting the REM option are not allowed to participate in the energy market.
Self-Schedule	Yes	No	Because NGRs selecting the REM option are not allowed to participate in the energy market, they cannot self-schedule. Non REM NGRs can self-schedule as price takers only.
Ancillary Services			NGRs are not allowed to self-provide Ancillary Services
Regulation Down	Yes	Yes	
Regulation Up	Yes	Yes	
Spinning Reserve	Yes	No	NGRs selecting the REM option are only allowed to supply regulation.
Non-Spinning Reserve	Yes	No	NGRs selecting the REM option are only allowed to supply regulation.
Operational Ramp Rate	Yes	Yes	NGRs are limited to two segments.
Operating Reserve Ramp Rate	No	No	NGRs are not allowed to submit Operating Reserve Ramp Rates. Operational Ramp rate shall be used for procurement of AS.
Regulation Ramp Rate	No	No	NGRs are not allowed to submit Regulation Ramp Rates. Operational Ramp rate shall be used for procurement of AS.
Contingency Dispatch Indicator	Yes	N/A	Does not apply to REM resources because they cannot supply spinning or non-spinning reserve.
Intertie Minimum Hourly Block	N/A	N/A	Does not apply to NGRs because NGRs must be located within the CAISO balancing authority.
Dispatch Option	N/A	N/A	Does not apply to NGRs because NGRs must be located within the CAISO balancing authority.

Bid component	Allowed for non REM?	Allowed for REM?	Comment
Pump Shut-Down Cost	No	No	By nature NGRs do not have pump shut-down costs.
Pumping Cost	No	No	By nature NGRs do not have pumping costs.
Daily Energy Limit (Maximum and Minimum Daily)	No	No	However NGRs do bid an upper and lower charge limit, which is a similar concept.
RUC	No	No	
Capacity Limit	Yes	Yes	
Distribution Factors	Yes	Yes	Assumption is that all underlying resources are operating in the same mode, either all must be in charging mode or all must be in discharging mode.
VER Forecast	N/A	N/A	Does not apply to NGRs because NGRs cannot be a VER.
The following bid components apply to NGRs only			
Lower Charge Limit	Yes	Yes	Lowest stored energy that should be maintained in the device. Cannot be lower than the minimum stored energy value registered in the Master File.
Upper Charge Limit	Yes	Yes	Highest stored energy that should be maintained in the device. Cannot be higher than the maximum stored energy value (MSE) registered in the Master File.

## **Attachment G**

# **MAXIMUM START-UP AND MINIMUM LOAD VALUES UNDER THE REGISTERED AND PROXY COST OPTIONS**

## G Registered and Proxy Cost Options

This attachment explains how Start-up and Minimum Load Costs are calculated under the Registered and Proxy Cost options and the maximum allowable values for each. Only resources with use-limited capacity may select the Registered Cost Option, pursuant to tariff section 30.4. See Attachment H for Transition Cost calculations for multi-stage generating resources.

In case market-based rate authority is suspended, the Scheduling Coordinator responsible for submitting the resource's Minimum Load and Start-Up Costs subject to Appendix II of the tariff will not be entitled to select the Registered Cost option available under Section 30.4.1.2 and can only select the Proxy Cost option as specified in Section 30.4.1.1 of the CAISO Tariff for their Minimum Load and Start-Up Costs. If the resource lacks a Start-Up or Minimum Load Cost in any market intervals, the CAISO will insert the Start-Up or Minimum Load Costs calculated based on the Proxy Cost option.

### G.1 Registered Cost Option

Units selecting the Registered Cost Option in the Master File must also submit values for Start-up and Minimum Load Costs in the Master File, as described in Attachment B. Multi-Stage Generating units selecting the Register Cost Option in the Master File must also submit values for Transition Costs in the Master File, as described in Attachment B.

Before approving Start-up and Minimum Load Cost values submitted under the Registered Cost Option, the Master File analyst will review the values to determine if they are within the allowable levels.

- Start-Up, Minimum Load, and Transition Costs<sup>23</sup> under the Registered Cost Option may not exceed 150 percent of the unit's Projected Proxy Cost for Start-Up, Minimum Load, and Transition Costs.

The registered Start-up, Minimum Load, and Transition Cost values for units selecting the Registered Cost Option may not be modified for a period of 30 days after becoming effective. However, the SC may switch to the Proxy Cost Option during this period if fuel costs increase such that the unit's actual Start-up and Minimum Load Costs, as calculated under the Proxy Cost Option, exceed the unit's registered value under the Registered Cost Option in the Master File. Unit's switching from the Registered Cost Option to the Proxy Cost Option during this 30 day period must remain on the Proxy Cost Option for the remainder of this 30 day period. Transition Costs will not be evaluated for switching. However, if the Start-up Cost is switched

<sup>23</sup> See Attachment H for transition cost calculations.

from Registered to Proxy Cost, then the Transition Costs will also be switched from Registered to Proxy Cost at the same time.

If the Start-up, Minimum Load, or Transition costs exceed the maximum limit after the 30 day period expires, the costs will be lowered to the maximum limit currently in effect, as outlined in the following section.

### **Monthly Validation of Registered Costs**

On a monthly basis, the CAISO will review the Master File Start-up, Minimum Load, and Transition Cost values for units that had selected the Registered Cost Option to identify resources that have registered cost values over the allowable cap.

- Within 3 business days following the first day of the month, CAISO will review the existing registered cost values that were in effect on the first of the month and identify those resources that have registered cost values over the allowable cap.  
NOTE: Resources that had a change to minimum load or startup costs within the previous 30 days will be excluded from this review.
- Within 5 business days following the first day of the month, CAISO will communicate a list of the affected resources to the Scheduling Coordinator (SC) requesting that registered cost values be revised to comply with the new limits.
- The SC will have until the 8th business day of the month to submit a valid revised RDT, with an effective date no later than the 15th business day of the month.
- If the SC has not submitted a valid revised RDT by the 8th business day of the month, the Master File analyst will apply the new registered cost cap using an effective date of the 15th business day of the month.

### **CAISO Validation of SC-requested Change to Registered Costs**

A SC may submit a GRDT to change the Start-up, Minimum Load, and Transition Cost values for a resource where these values have not been modified within the previous 30 days.

- The SC submits a GRDT with change(s) to Start-up, Minimum Load, and/or Transition Costs.

- CAISO validates that the requested effective date is no greater than 15 business days from the date of submittal.
- CAISO validates that the costs do not exceed the applicable limit based on the gas price that was posted on the day the SC submitted their request.
- If the requested cost values exceed the cap, CAISO will decline the request.
- If the requested costs are within the applicable limit, and no other validation errors occur, the change will be approved and the affected resource will be excluded from the following monthly validation of registered costs.

## **G.1.1 Natural Gas Units**

### **G.1.1.1 Maximum Registered Start-up Costs**

For purposes of determining maximum Start-up costs that may be approved for gas-fired units under the Registered Cost Option, the projected Start-up costs will be calculated by combining the unit's Startup fuel and electrical energy consumption curves in the Master File and the projected gas price calculated as described in Section G.2, plus a Grid Management Charge (GMC) adder representing the Market Services Charge and System Operations Charge components. If the resource is subject to a greenhouse gas compliance obligation (as indicated by a 'Y' in the GHG\_COMPLIANCE\_OBLIG field in Master File), the CAISO will add to the projected Start-up costs the greenhouse gas allowance start-up cost. The cost will be calculated per Attachment K, using the projected Greenhouse Gas Allowance Price described in section G.3. In addition, if the resource has established a major maintenance adder with the CAISO or its designated agent, the CAISO or its designated agent will add a major maintenance cost adder (MMA). See Attachment L for details.

For purposes of this calculation, the cost of any auxiliary power needed for start-up (as indicated in the STARTUP\_ENERGY field in the Master File) will be calculated by using an estimated electricity price equal to the projected gas price multiplied by a factor of 10. This represents a projected electricity price during unit start-up or cost of auxiliary power provided by the generator based on a unit with a heat rate of 10,000 Btu/KWh.

### **Example: Registered Start-up Cost Calculation and Bid Cap for Gas-Fired Resource**

An example of this calculation based on a gas price of \$8.50/MMBtu is provided in the following table.

For purposes of the GMC adder, assume a PMin of 20 MW, a Start-Up Time Period of 600 minutes, and a GMC adder of \$0.50/MWh (made up of a \$0.15/MWh Market Services Charge and a \$0.35/MWh System Operations Charge). Note that the fastest Start-Up Time Period registered in the Master File is used in this calculation, regardless of segment. In other words, even for warm starts or cold starts, the fastest start-up time will be used. For MSG resources this applies to the configuration, *i.e.*, use the fastest time period registered for the segment, not the entire resource.

Start-Up Cost = (Start-Up Fuel x Gas Price) + (Start-Up Energy x Gas Price x Gas Price Multiplier) + (PMin x Start-Up Time Period in min / 60 min/hour x GMC adder / 2)

Gas Price = 8.50/MMBtu  
Gas Price Multiplier = 10

Example of start-up cost calculation (first Start-Up segment):

Start-Up Cost = (1,083 MMBtu x \$8.50/MMBtu) + (20MWh x \$8.50 MMBtu x 10) + (20 MW x (600 minutes/(60 minutes/hour)) x \$0.50/MWh / 2)  
= (9,205.5) + (1,700) + (50)  
= 10,955.50  
= 10,956 (rounded)

**Start-Up Costs including a GHG Compliance Obligation:**

Start-Up Cost = (Start-Up Fuel x Gas Price) + (Start-Up Energy x Gas Price x Gas Price Multiplier) + (PMin x Start-Up Time Period in min / 60 min/hour x GMC adder / 2) + (Start-Up Fuel x GHG Emission Rate x GHG Allowance Price)

GHG Allowance Price = \$15.34/mtCO<sub>2</sub>e  
GHG Emission Rate = 0.053165 mtCO<sub>2</sub>e /MMBtu

Example of start-up:

Start-Up Cost = (1,083 MMBtu x \$8.50/MMBtu) + (20MWh x \$8.50 MMBtu x 10) + (20 MW x (600 minutes / (60minutes/hour)) x \$0.50/MWh / 2) + (1,083 MMBtu x 0.053165 mtCO<sub>2</sub>e /MMBtu x \$15.34)  
= (9,205.5) + (1,700) + (50) + (883.24)  
= 11,838.74  
= 11,839 (rounded)

**Start-Up Costs including a major maintenance cost adder:**

The major maintenance cost adder is a single line item that is added to the Start-Up Cost. Continuing the example above:

Assume major maintenance cost adder calculated by the CAISO is \$800.98 (same value applied to all segments).

$$\begin{aligned}
 \text{Start-Up Cost} &= \$11,838.74 + \text{major maintenance cost adder} \\
 &= \$11,838.74 + 800.98 \\
 &= \$12,639.72 \\
 &= \$12,640 \text{ (rounded)}
 \end{aligned}$$

**Table G1. Example of Projected Start-up Cost and Maximum Registered Cost Bid Calculation (Gas Price = \$8.50/MMBtu)**

	Cooling Time (minutes)	Start-Up Time (minutes)	Start-Up Fuel (MMBtu)	Start-Up Energy (MWh)	Start-Up Cost w/o GHG/MMA (\$)	Start-Up Cost with GHG & MMA (\$)	Max Start-Up Bid w/o GHG/MMA (\$)	Max Start-Up Bid with GHG & MMA (\$)
Hot	0	600	1,083	20	\$10,956	\$12,640	\$16,433	\$18,960
Warm	240	1390	1,633	40	\$17,396	\$19,529	\$26,059	\$29,294
Cold	480	1400	2,000	60	\$22,217	\$24,649	\$33,325	\$36,973

**G.1.1.2 Maximum Registered Cost Minimum Load Costs**

For purposes of determining maximum Minimum Load Cost that may be approved for gas-fired units under the Registered Cost Option, the projected Minimum Load Cost will be calculated using the unit's Minimum Load Heat Rate and the projected gas price calculated as described in Section G.1.2, plus a GMC adder made up of the Market Services Charge and System Operations Charge components and a third value representing the Bid Segment Fee component divided by the resource Pmin. If the resource is subject to a greenhouse gas compliance obligation (as indicated by a 'Y' in the GHG\_COMPLIANCE\_OBLIG field in Master File), the CAISO will add to the projected Minimum Load Cost the Greenhouse gas allowance minimum load cost. The cost will be calculated per Attachment K, using the projected Greenhouse Gas Allowance Price described in section G.1.3. In addition, if the resource has a major maintenance adder approved by the CAISO, the CAISO will add a major maintenance cost adder (MMA). See Attachment L for details.

The Minimum Load Cost for a unit cannot exceed the applicable limit of 150% of the unit's Projected Proxy Cost for Minimum Load Costs. The calculation and an example are provided here.

**Projected Minimum Load Cost** = (Unit Conversion Factor x Minimum Load Heat Rate x Minimum Operating Level x Gas Price) + (O&M x Minimum Operating Level) + (GMC adder x Minimum Operating Level)

Example:

Gas Price = 8.50/MMBtu

O&M adder = \$4/MWh

GMC adder = \$0.50/MWh

$$\begin{aligned}\text{Minimum Load Cost} &= (0.001 \times 14,000\text{Btu/kWh} \times 20\text{MW} \times \$8.50/\text{MMBtu}) + (\$4/\text{MWh}^{24} \\ &\times 20\text{MW}) + (\$0.50/\text{MWh} \times 20\text{MW}) \\ &= (\$2,380) + (\$80) + (\$10) \\ &= \$2,470\end{aligned}$$

**Minimum Load Cost with a GHG component** = (Unit Conversion Factor x Minimum Load Heat Rate x Minimum Operating Level x Gas Price) + (O&M x Minimum Operating Level) + (GMC adder x Minimum Operating Level) + (Minimum Operating Level x Unit Conversion Factor x Minimum Load Heat Rate x Emission Rate x GHG Allowance Price)

Example:

Emission Rate = 0.053165 mtCO<sub>2</sub>e /MMBtu

GHG Allowance Price = \$15.34/mtCO<sub>2</sub>e

$$\begin{aligned}&= (0.001 \times 14,000\text{Btu/kWh} \times 20\text{MW} \times \$8.50/\text{MMBtu}) + (\$4/\text{MWh} \times 20\text{MW}) + (\$0.50/\text{MWh} \\ &\times 20\text{MW}) + (20\text{MW} \times 0.001 \times 14,000\text{Btu/kWh} \times 0.053165 \text{ mtCO}_2/\text{MMBtu} \times 15.34) \\ &= (\$2,380) + (\$80) + (10) + (\$228) \\ &= \$2,698\end{aligned}$$

#### **Minimum Load Costs including a major maintenance cost adder:**

The major maintenance cost adder is a single line item that is added to the Minimum Load cost. Continuing the example above:

Assume major maintenance cost adder calculated by the CAISO is \$105.19.

$$\text{Minimum Load Cost} = \$2,695 + \text{major maintenance cost adder}$$

<sup>24</sup> This example assumes a \$4/MWh O&M adder.

$$= \$2,698 + 105$$

$$= \$2,803$$

**Table G2. Example of Projected Minimum Load Bid and Maximum Bid Calculation**  
**Gas Price = \$8.50/MMBtu**

Minimum Operating Level (MW)	Heat Rate (MBtu/MWh)	O&M Cost (\$/MWh)	Minimum Load Cost (\$)	GHG Allowance Cost & MMA (\$/MWh)	Minimum Load Cost with GHG & MMA (\$)	Max MLC Bid w/o GHG/MM A (\$)	Max MLC Bid with GHG & MMA (\$)
20	14,000	4	\$2,470	\$333	\$2,803	\$3,705	\$4,205

### G.1.2 Gas Price Used in Start-up and Minimum Load Cost Caps

After the twenty-first day of each month, the CAISO will calculate a gas price to be used in calculating maximum Start-up and Minimum Load costs that may be registered by gas units under the Registered Cost Option. The resulting gas price will be posted on the CAISO website by the end of each calendar month. The price will be applicable for any unit submitting or revising a Start-up and Minimum Load value under the Registered Cost Option for the following month until a new gas price is calculated and posted on the CAISO website. The gas price will be calculated as follows.

First, daily closing prices for monthly natural gas futures contracts at Henry Hub for the next month are averaged over the first twenty one days of the month, resulting in a single average for the next calendar month. Closing prices for only the first twenty-one days of the month are used in order to allow at least one week for the calculations to be completed and posted on the CAISO website by the end of each month. The purpose of averaging daily closing prices over this twenty-one day period is to avoid unusually high or low values that may result from taking prices on only one day.

Second, the average monthly price for futures contracts for basis swaps at the PG&E CityGate natural gas delivery point and futures contracts for basis swaps at the SoCal CityGate natural gas delivery point in California are calculated, using data for the first 21 trade dates in the month.

Consistent with the approach used by the CAISO or its designated agent to calculate the GPI for daily spot market prices used to calculate DEBs and bids under the Proxy Cost option, the

SoCal CityGate prices are ultimately used for units in the SCE and SDG&E areas, while the PG&E Citygate prices are used for units in the PG&E area.

The next step is to combine the average Henry Hub price and the average basis swap price for each of these two delivery points for each month.

Consistent with the approach used by the CAISO or its designated agent to calculate the GPI for daily spot market prices, the final step is to add the appropriate intra-state transport price.

For units in the SCE and SDG&E areas, the CAISO or its designated agent uses the applicable gas transportation rate from the Southern California Gas Company.<sup>25</sup>

For units in the PG&E area, the CAISO or its designated agent uses rates from PG&E's Gas Schedule G-EG for Gas Transportation Service to Electric Generation.<sup>26</sup>

The source of gas price data used in this calculation will be the Natural Gas Intelligence Daily, or, if necessary, another available source of closing prices for natural gas futures contracts for each trade date.

### **G.1.3 Greenhouse Gas Allowance Price Used in Start-up and Minimum Load Cost Caps**

After the twenty-first day of each month, the CAISO will calculate a projected Greenhouse Gas Allowance Price to be used in calculating maximum Start-up and Minimum Load costs that may be registered by gas units under the Registered Cost Option. The resulting projected Greenhouse Gas Allowance Price will be posted on the CAISO website by the end of each calendar month. The price will be applicable for any unit submitting or revising a Start-up and Minimum Load value under the Registered Cost Option for the following month until a new projected Greenhouse Gas Allowance Price is calculated and posted on the CAISO website.

The projected Greenhouse Gas Allowance Price will be calculated by averaging the daily Greenhouse Gas Allowance Prices from the first twenty days of the month, resulting in a single average for the next calendar month. Closing prices for only the first twenty days of the month are used in order to allow at least one week for the calculations to be completed and posted on

<sup>25</sup> <http://www.socalgas.com/regulatory/tariffs/tm2/pdf/GT-F.pdf>.

<sup>26</sup> [http://www.pge.com/tariffs/tm2/pdf/GAS\\_SCHS\\_G-EG.pdf](http://www.pge.com/tariffs/tm2/pdf/GAS_SCHS_G-EG.pdf)

the CAISO website by the end of each month. Per the price principles established in Attachment K, the Daily Greenhouse Gas Allowance price is set at the last valid daily price based on two sources if a given day does not have two sources. A Daily Greenhouse Gas Allowance price set using the last valid daily price based on two sources is included in the calculation of the projected Greenhouse Gas Allowance Price. The purpose of averaging daily closing prices over this twenty day period is to avoid unusually high or low values that may result from taking prices on only one day.

#### **G.1.4 Non-Gas Units**

For non-gas units, maximum Start-up and Minimum Load values under the Registered Cost Option will be based on Start-up and Minimum Load cost information submitted and validated by the CAISO for each unit under the requirements for the Proxy Cost Option, plus a GMC adder representing the Market Services Charge and System Operations Charge components and a third value representing the Bid Segment Fee component divided by the bid segment MW size. The adder is calculated the same as for gas-fired units as explained above. Start-Up and Minimum Load Costs under the Registered Cost Option may not exceed 150 percent of the unit's validated Start-Up and Minimum Load Costs under the Proxy Cost Option.

For non-natural gas-fired resources subject to a greenhouse gas compliance obligation (as indicated by a 'Y' in the 'GHG\_COMPLIANCE\_OBLIG' field in Master File), the SC should include the greenhouse gas allowance cost in the Start-up and Minimum Load cost values submitted under the Registered Cost Option.

The CAISO shall include major maintenance costs for non-natural gas-fired resources that have established a major maintenance adder. See Attachment L for details.

As part of the process of validating Start-Up and Minimum Load Costs submitted under the Proxy cost Option, the CAISO may request additional information from the Scheduling Coordinator.

#### **G.2 Proxy Cost Option**

Scheduling Coordinators with resources subject to the Proxy Cost Option must also submit values for Start-up and Minimum Load Cost in the Master File, as described in Attachment B. Multi-stage generating resources must also submit values for Transition Costs in the Master File, as described in Attachment B.

## **G.2.1 Natural Gas Units**

### **G.2.1.1 Maximum Proxy Cost Start-up Costs**

For purposes of determining maximum Start-up costs<sup>27</sup> that may be approved for gas-fired units under the Proxy Cost Option, the calculated Start-up costs will be calculated by combining the unit's Startup fuel and electrical energy consumption curves in the Master File, the daily Gas Price Index calculated as described in Attachment C and the electricity price index as described in attachment M, plus a Grid Management Charge (GMC) adder representing the Market Services Charge and System Operations Charge components. If the resource is subject to a greenhouse gas compliance obligation (as indicated by a 'Y' in the GHG\_COMPLIANCE\_OBLIG field in Master File), the CAISO will add to the calculated Start-up costs the greenhouse gas allowance start-up cost. The cost will be calculated per Attachment K, using the Greenhouse Gas Allowance Price described in Attachment K. In addition, if the resource has major maintenance expenses approved by the CAISO, the CAISO will add a major maintenance cost adder (MMA). See Attachment L for details.

For purposes of this calculation, the cost of any auxiliary power needed for start-up (as indicated in the STARTUP\_ENERGY field in the Master File) will be calculated multiplying the MWh energy input with the Electricity Price Index. See Attachment M for details.

A Scheduling Coordinator may bid Start-up Costs daily. The Start-up Cost bid for a unit cannot exceed the applicable limit of 125 percent of the unit's calculated Proxy Cost for Start-up Costs. For multi-stage generating resources, a Scheduling Coordinator may bid Transition Costs daily.<sup>28</sup> The Transition Cost bid for a unit cannot exceed the applicable limit of 125 percent of the unit's calculated Proxy Cost for Transition Costs. If the Scheduling Coordinator does not bid, the CAISO will generate daily bids based on the calculated Proxy Costs.

### **Example: Proxy Start-up Cost Calculation and Bid Cap for Gas-Fired Resource**

An example of this calculation based on a natural gas price index of \$8.50/MMBtu is provided in the following table.

<sup>27</sup> Multi-stage generating resources have both start-up and indicative start-up costs, as described in greater detail in Attachment H. This section refers to both generically as start-up costs.

<sup>28</sup> See Attachment H for transition cost calculations.

For purposes of the GMC adder, assume a PMin of 20 MW, a Start-Up Time Period of 600 minutes, and a GMC adder of \$0.50/MWh (made up of a \$0.15/MWh Market Services Charge and a \$0.35/MWh System Operations Charge). Note that the fastest Start-Up Time Period registered in the Master File is used in this calculation, regardless of segment. In other words, even for warm starts or cold starts, the fastest start-up time will be used. For MSG resources this applies to each configuration. That is, the fastest time period registered for the segment, not the entire resource, will be used.

Start-Up Cost = (Start-Up Fuel x Gas Price) + (Start-Up Energy x Electricity Price Index) + (PMin x Start-Up Time Period in min / 60 min/hour x GMC adder / 2)

Gas price index = 8.50/MMBtu

Example of start-up cost calculation (first Start-Up segment):

$$\begin{aligned}\text{Start-Up Cost} &= (1,083 \text{ MMBtu} \times \$8.50/\text{MMBtu}) + (20\text{MWh} \times \$80/\text{MWh}) + (20 \text{ MW} \times (600 \\ &\text{minutes}/(60 \text{ minutes}/\text{hour})) \times \$0.50/\text{MWh} / 2) \\ &= (9,205.5) + (1,600) + (50) \\ &= 10,855.50 \\ &= 10,856 \text{ (rounded)}\end{aligned}$$

**Start-Up Costs including a GHG Compliance Obligation:**

Start-Up Cost = (Start-Up Fuel x Gas Price) + (Start-Up Energy x Electricity Price Index) + (PMin x Start-Up Time Period in min / 60 min/hour x GMC adder / 2) + (Start-Up Fuel x GHG Emission Rate x GHG Allowance Price)

GHG Allowance Price = \$15.34/mtCO<sub>2</sub>e  
GHG Emission Rate = 0.053165 mtCO<sub>2</sub>e /MMBtu

Example of start-up:

$$\begin{aligned}\text{Start-Up Cost} &= (1,083 \text{ MMBtu} \times \$8.50/\text{MMBtu}) + (20\text{MWh} \times \$80/\text{MWh}) + (20 \text{ MW} \times (600 \\ &\text{minutes} / (60\text{minutes}/\text{hour})) \times \$0.50/\text{MWh} / 2) + (1083 \text{ MMBtu} \times 0.053165 \text{ mtCO}_2\text{e} /\text{MMBtu} \times \\ &\$15.34) \\ &= (9,205.5) + (1,600) + (50) + (883.24) \\ &= 11,738.74 \\ &= 11,739 \text{ (rounded)}\end{aligned}$$

**Start-Up Costs including a major maintenance cost adder:**

The major maintenance cost adder is a single line item that is added to the Start-Up Cost. Continuing the example above:

Assume major maintenance cost adder approved by the CAISO is \$800.98 (same value applied to all segments).

$$\begin{aligned}
 \text{Start-Up Cost} &= \$11,738.74 + \text{major maintenance cost adder} \\
 &= \$11,738.74 + 800.98 \\
 &= \$12,539.72 \\
 &= \$12,540 \text{ (rounded)}
 \end{aligned}$$

**Table G3. Example of Calculated Start-up Cost and Maximum Proxy Cost Bid Calculation (Gas Price = \$8.50/MMBtu, EPI = \$80/MWh)**

	Cooling Time (minutes)	Start-Up Time (minutes)	Start-Up Fuel (MMBtu)	Start-Up Energy (MWh)	Start-Up Cost w/o GHG/MMA (\$)	Start-Up Cost with GHG & MMA (\$)	Max Start-Up Bid w/o GHG/MMA (\$)	Max Start-Up Bid with GHG & MMA (\$)
Hot	0	600	1,083	20	\$10,856	\$12,540	\$13,569	\$15,675
Warm	240	1390	1,633	40	\$17,196	\$19,329	\$21,495	\$24,161
Cold	480	1400	2,000	60	\$21,917	\$24,349	\$27,396	\$30,436

### G.2.1.2 Maximum Proxy Cost Minimum Load Costs

For purposes of determining maximum Minimum Load Cost that may be calculated for gas-fired units under the Proxy Cost Option, the calculated Minimum Load Cost will be calculated using the unit's Minimum Load Heat Rate and the daily Gas Price Index calculated as described in Attachment C, plus a GMC adder made up of the Market Services Charge and System Operations Charge components and a third value representing the Bid Segment Fee component divided by the resource Pmin. If the resource is subject to a greenhouse gas compliance obligation (as indicated by a 'Y' in the GHG\_COMPLIANCE\_OBLIG field in Master File), the CAISO will add to the calculated Minimum Load Cost the Greenhouse gas allowance minimum load cost. The cost will be calculated using the Greenhouse Gas Allowance Price described in Attachment K. In addition, if the resource has minimum load major maintenance adder approved by the CAISO, the CAISO will add a major maintenance cost adder (MMA). See Attachment L for details.

A Scheduling Coordinator may submit daily bids for Minimum Load Costs up to the cap of 125 percent of the unit's calculated Proxy Cost for Minimum Load Costs. If the Scheduling Coordinator does not bid, the CAISO will generate daily bids based on the calculated Proxy Costs. The calculation and an example are provided below.

### **Example: Proxy Minimum Load Cost Calculation and Bid Cap for Gas-Fired Resource**

Minimum Load Cost Cap = (Unit Conversion Factor x Minimum Load Heat Rate x Minimum Operating Level x Gas Price) + (O&M x Minimum Operating Level) + (GMC adder x Minimum Operating Level)

Example:

Gas price index = 8.50/MMBtu

O&M adder = \$4/MWh

GMC adder = \$0.50/MWh

$$\begin{aligned}\text{Minimum Load Cost} &= (0.001 \times 14,000\text{Btu/kWh} \times 20\text{MW} \times \$8.50/\text{MMBtu}) + (\$4/\text{MWh}^{29} \\ &\times 20\text{MW}) + (\$0.50/\text{MWh} \times 20\text{MW}) \\ &= (\$2,380) + (\$80) + (\$10) \\ &= \$2,470\end{aligned}$$

**Minimum Load Cost with a GHG component** = (Unit Conversion Factor x Minimum Load Heat Rate x Minimum Operating Level x Gas Price) + (O&M x Minimum Operating Level) + (GMC adder x Minimum Operating Level) + (Minimum Operating Level x Unit Conversion Factor x Minimum Load Heat Rate x Emission Rate x GHG Allowance Price)

Example:

Emission Rate = 0.053165 mtCO<sub>2</sub>e /MMBtu

GHG Allowance Price = \$15.34/mtCO<sub>2</sub>e

$$\begin{aligned}&= (0.001 \times 14,000\text{Btu/kWh} \times 20\text{MW} \times \$8.50/\text{MMBtu}) + (\$4/\text{MWh} \times 20\text{MW}) + (\$0.50/\text{MWh} \\ &\times 20\text{MW}) + (20\text{MW} \times 0.001 \times 14,000\text{Btu/kWh} \times 0.053165 \text{ mtCO}_2/\text{MMBtu} \times 15.34) \\ &= (\$2,380) + (\$80) + (\$10) + (\$228) \\ &= \$2,698\end{aligned}$$

**Minimum Load Costs including a major maintenance cost adder:**

<sup>29</sup> This example assumes a \$4/MWh O&M adder.

The major maintenance cost adder is a single line item that is added to the Minimum Load cost. Continuing the example above:

Assume major maintenance cost adder approved by the CAISO is \$105.19.  
 Minimum Load Cost = \$2,695 + major maintenance cost adder  
 = \$2,698 + 105  
 = \$2,803

**Table G4. Example of Calculated Minimum Load Cost and Maximum Bid Calculation**  
**Gas Price Index = \$8.50/MMBtu**

Minimum Operating Level (MW)	Heat Rate (MBtu/MWh)	O&M Cost (\$/MWh)	Minimum Load Cost (\$)	GHG Allowance Cost & MMA (\$/MWh)	Minimum Load Cost with GHG & MMA (\$)	Max MLC Bid w/o GHG/MM A (\$)	Max MLC Bid with GHG & MMA (\$)
20	14,000	4	\$2,470	\$333	\$2,803	\$3,088	\$3,504

### G.2.2 Non-Gas Units

For non-gas units, maximum Start-up and Minimum Load values under the Proxy Cost Option will be based on Start-up, Minimum Load and Transition Cost information submitted and validated by the CAISO for each unit under the requirements for the Proxy Cost Option, plus a GMC adder representing the Market Services Charge and System Operations Charge components and a third value representing the Bid Segment Fee component divided by the bid segment MW size. The adder is calculated the same as for gas-fired units explained above. Start-Up, Minimum Load, and Transition Costs under the Proxy Cost Option may not exceed 125 percent of the unit's validated Start-Up, Minimum Load, and Transition Costs under the Proxy Cost Option.

For non-natural gas-fired resources subject to a greenhouse gas compliance obligation (as indicated by a 'Y' in the 'GHG\_COMPLIANCE\_OBLIG' field in Master File), the CAISO will add to the calculated Start-up costs the greenhouse gas allowance start-up cost. Start-up greenhouse gas compliance obligation costs may be calculated for non-gas thermal resources as they are for gas-fired resources if sufficient data is submitted in Master File (GHG Emission Rate and start-up fuel requirement (MMBTU/start-up)). The CAISO shall include major maintenance costs for non-natural gas-fired resources which have such costs approved by the CAISO. See Attachment L for details.

As part of the process of validating Start-Up, Minimum Load, and Transition Costs submitted under the Proxy cost Option, the CAISO may request additional information from the Scheduling Coordinator.