

## 2.6 Variable Maintenance Cost

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**Variable Maintenance cost** is the parts and labor expenses of maintaining equipment and facilities in satisfactory operating condition.

$$\begin{aligned} \text{TotalMaintenanceCost}_{\text{NextYear}} = & \\ & \left( \text{AnnualMaintenanceCost} * \frac{\text{EscalationIndex}_{\text{NextYear}}}{\text{EscalationIndex}_{\text{CurrentYear}}} \right) + \\ & \left( \text{AnnualMaintenanceCost} * \frac{\text{EscalationIndex}_{\text{NextYear}}}{\text{EscalationIndex}_{\text{LastYear}}} \right) + \\ & \left( \text{AnnualMaintenanceCost} * \frac{\text{EscalationIndex}_{\text{NextYear}}}{\text{EscalationIndex}_{\text{LastYear}-1}} \right) + \\ & \dots + \left( \text{AnnualMaintenanceCost} * \frac{\text{EscalationFactor}_{\text{NextYear}}}{\text{EscalationIndex}_{\text{LastYear}-(\text{Maintenance Period}-1)}} \right) \end{aligned}$$

The Maintenance Adder is based on all available maintenance expense history for the defined Maintenance Period (See 2.6.3) regardless of unit ownership. Only expenses incurred as a result of electric production qualify for inclusion. The Maintenance Adder should be reviewed (and updated if changed) at least annually. Maintenance Adders may be included as part of the start cost, no load, or incremental energy offer. Maintenance Adders may be specified as \$/Start, \$/Hour, \$/MMBtu, \$/Equivalent Operating Hour (EOH), and/or \$/MWh.

The Maintenance Adder must be submitted to PJM and the MMU for review annually, in accordance with Operating Agreement Schedule 2 Section 4. Market Sellers may only use the PJM-approved Maintenance Adder in their unit's cost-based offer. Approved Maintenance and Emissions adders expire December 31 of the year following acceptance.

Market Sellers may only change the format of the Maintenance and Operating Cost adder (i.e., \$/MMBtu, \$/MWh, \$/Start, etc.) during the annual review period. In addition, once the Maintenance and Operating Cost adder is approved by PJM, the adder can only be included in the corresponding portions of the associated cost based energy offer components (i.e., No-Load Costs, Incremental Energy Costs, Start-Up Costs).

If a Market Seller feels that a unit modification or required change in operating procedures will affect the unit's Maintenance Adder, the revised Maintenance Adder must be submitted to PJM and the MMU for review and PJM-approval prior to use in cost-based offers.

### 2.6.1 Allowable Maintenance Expenses

Maintenance Costs are expenses incurred as a result of electric production. Allowable expenses can include repair, replacement, inspection, and overhaul expenses, including Long Term Service Agreements (LTSA), related to the following systems and/or their associated FERC accounts identified later in this manual – steam turbine, gas turbine, generator, boiler, Heat Recovery Steam Generators (HSRG) , main steam, feed water, condensate, condenser, cooling towers, transformers, controls, and fuel systems. The major inspection and overhaul costs listed below in sections (a)-(c) are not exhaustive. A Market Seller may include costs in cost-based offers if those costs are similar to the costs outlined in this provision, so long as they are variable costs that are directly attributable to the production of electricity.

(a) Major inspections and overhauls of gas turbine and steam turbine generators include, but are not limited to, the following costs:

- turbine blade repair/replacement;
- turbine diaphragm repair;
- casing repair/replacement;
- bearing repair/refurbishment;
- seal repair/replacement and generator refurbishment;
- heat transfer replacement and cleaning;
- cooling tower fan motor and gearbox inspection;
- cooling tower fill and drift eliminators replacement;
- Selective Catalytic Reduction and CO Reduction Catalyst replacement;
- Reverse Osmosis Cartridges replacement;
- air filter replacement;
- fuel and water pump inspection/replacement.

(b) Major maintenance of gas turbine generators directly related to electric production include, but are not limited to:

- compressor blade repair/replacement;
- hot gas path inspections, repairs, or replacements.

(c) Major maintenance of steam turbine generators directly related to electric production include, but are not limited to:

- stop valve repairs;
- throttle valve repairs;
- nozzle block repairs;
- intercept valve repairs.

Maintenance Costs that cannot be included in a unit's cost-based offer are preventative maintenance and routine maintenance on auxiliary equipment like buildings, HVAC, compressed air, closed cooling water, heat tracing/freeze protection, and water treatment. Typically if the system is needed to remain in-service when the unit is not in operation expenses related to it cannot be included in a unit's cost based offer.

### 2.6.2 Labor Costs

Labor costs included in cost-based offers are limited to start-up costs for additional staffing requirements and do not include straight-time labor costs. Only staff overtime or contractor labor incurred for costs referenced in Section 2.6.1 of Manual 15 can be included in maintenance adder. Staff overtime or contractor labor to augment existing operations staff to run the unit cannot be included in the unit's cost-based offer.

### 2.6.3 Escalation Index

**Escalation Index** is the annual escalation index derived from the July 1 Handy - Whitman Index Table E-1, line 6, "construction cost electrical plant".

#### Handy Whitman Index

YEAR	INDEX	ESCALATION FACTOR
1999	389	1.878
2000	415	1.836
2001	425	1.793
2002	438	1.740
2003	441	1.728
2004	465	1.639
2005	493	1.546
2006	515	1.480
2007	546	1.396
2008	596	1.279
2009	578	1.318
2010	604	1.262
2011	631	1.208
2012	645	1.181
2013	653	1.167
2014	672	1.134
2015	700	1.089
2016	714	1.067
2017	711	1.072
2018	745	1.023
2019	762 (est)	1.000

### 2.6.4 Maintenance Period

A unit must choose a rolling historical period based on calendar year. A unit may choose a 10-year or 20-year period for maintenance cost. Once a unit has chosen the historical period length, the unit must stay with that period until a significant unit configuration change. Significant unit configuration change is defined as any change to the physical unit's system that significantly affects the maintenance cost for a period greater than 10 years. Examples of a significant unit configuration may include but are not limited to:

- Flue Gas Desulfurization (FGD or scrubber)

- Activated Carbon Injection (ACI)
- Selective Catalytic NOx Reduction (SCR)
- Selective Non-Catalytic NOx Reduction (SNCR)
- Low-NOx burners
- Bag House addition
- Long-term Fuel change (greater than 10 years)
- Water injection for NOx control
- Turbine Inlet Air Cooling

A maintenance period choice may also be given in circumstances of change in ownership necessitating a new Interconnection Service Agreement (ISA). Change of ownership within the same holding company is not eligible to change the historical maintenance period.

Total Maintenance Dollars must be calculated for the same historical period as Equivalent Service Hours.

### 2.6.5 Incremental Adjustment Parameter

Incremental Adjustment Parameter is defined as any variable cost incurred in the production of energy for PJM dispatch that is not included in the CDS guidelines for Total Fuel Related Costs or Maintenance Adder. This includes any variable cost that has been previously approved pursuant to Cost Methodology and Approval Process for inclusion. These records shall be made available to PJM and MMU upon request.

### 2.6.6 Equivalent Hourly Maintenance Cost

- The hourly Maintenance Cost in dollars per hour. This is defined as total maintenance dollars divided by equivalent service hours or total fuel, depending on unit type.

$$\text{EquivalentHourlyMaintenance } (\$/\text{Hour}) =$$

$$\frac{\text{TotalMaintenanceDollars}}{\text{EquivalentServiceHours}}$$

Or

$$\text{EquivalentHourlyMaintenance } (\$/\text{MBTU}) = \frac{\text{TotalMaintenanceDollars}}{\text{TotalFuel}}$$

- Estimated Year 2011 Total Maintenance Cost calculation example for a CT:

$$\text{TotalMaintenanceCost}_{2011} =$$

$$\left( \text{AnnualMaintenanceCost}_{2010} * \frac{\text{EscalationIndex}_{2011}}{\text{EscalationIndex}_{2010}} \right) +$$

$$\left( \text{AnnualMaintenanceCost}_{2009} * \frac{\text{EscalationIndex}_{2011}}{\text{EscalationIndex}_{2009}} \right) +$$

$$\left(AnnualMaintenanceCost_{2008} * \frac{EscalationIndex_{2011}}{EscalationIndex_{2008}}\right) +$$

$$\dots + \left(AnnualMaintenanceCost_{2000} * \frac{EscalationIndex_{2011}}{EscalationIndex_{2000}}\right)$$

- Estimated Year 2011 Equivalent Service Hours calculation example:

$$EquivalentServiceHours =$$

$$(CyclicStartingFactor * NumberOfStarts) + TotalOperatingHours +$$

$$(CyclicPeakingFactor * NumberOfHoursAboveBaseload)$$

Cyclic Starting Factors and Cyclic Peaking Factors values shall be consistently used for equivalent service hours and cost based offer calculations for CC and CT Units. See cyclic starting factor and cyclic peaking factor in sections 5.6.3 & 6.6.3.

$EquivalentHourlyMaintenanceCost(\$ / Hour) =$ $\frac{TotalMaintenanceDollars}{EquivalentServiceHours}$
<p>For Example:</p> $\frac{\$406,236}{118,348 \text{ hours}} = \$3.43 / Hour$

Example Calculation of Maintenance Adder for CT using a 10 year Maintenance Period

### 2.6.7 Immature Units: Maintenance Costs

**Immature Units** - Units with neither 10 years of operation nor 50,000 Operating Hours.

Immature Units should use actual available costs.

When a resource has less than one calendar year of operating history available, the Market Seller may use the Variable Operations and Maintenance value for its resource class published by Monitoring Analytics in the latest Annual State of the Market Report.

Once a unit reaches either 10 years of operation or 50,000 Operating Hours, it is considered a mature unit. Once a unit is mature, it will use actual historical maintenance cost and the Market Seller will decide to use a 10 or 20 year history (See section 2.6.2). If a mature unit has less maintenance history than its elected historical period, the Market Seller will use all available history to calculate the Maintenance Adder.

