Working to Perfect the Flow of Energy

PJM Manual 15:

Cost Development Guidelines

Revision: 18

Effective Date:

Prepared by

Cost Development Subcommittee

Section 1: Introduction

1.7.3 No Load Cost

N**o-load cost** – The no-load cost is the cost needed to create the starting point of a monotonically increasing incremental cost curve. The calculated no-load cost may have to be adjusted to ensure that the slope of the Generator Offer Curve is monotonically increasing.

Section 2: Policies for All Unit Types

2.5 No Load

2.5.1 No-Load Definitions

No-load cost is the hourly fixed cost, expressed in $/hr, required to create the starting point of a monotonically increasing incremental cost curve.

2.5.2 No-Load Fuel

All PJM members shall develop no-load costs for their units. The no-load heat input curve may be determined by collecting heat input values as a function of output and performing a regression analysis. The heat input values as a function of output may be either created from heat rate testing data or the initial design heat input curve for an immature unit.

The minimum number of points to develop a heat input curve shall be 2 points for a dispatchable unit with a variable output and 1 point for a unit with a fixed output..

Sufficient documentation for each generating unit's no-load point in MBTUs (or fuel) per hour shall consist of a single contact person and/or document to serve as a consistent basis for scheduling, operating and accounting applications The MMU can verify calculation methods used subject to the Cost Methodology and Approval Process.

As unit types are added to M15, no-load will be addressed in the appropriate sections.

2.5.3 No Load Calculation

The initial estimate of a unit's **No-Load Cost ($/Hr)** is the No-Load fuel Cost multiplied by the performance factor, multiplied by the (Total Fuel-Related Cost (TFRC))

$$\text{No Load Cost(\$ / Hour)} =$$

$$(\text{No Load Fuel} * \text{Performance Factor} * \text{TFRC})$$

The calculated no-load cost should be adjusted to allow for the first incremental point of the unit's generator offer curve to comply with PJM's monotonically increasing curve requirement. The no-load cost is calculated by subtracting the incremental cost (unit's economic minimum cost-offer value multiplied by MW value) at the unit's economic minimum point from the total cost (from the heat input at economic minimum value) at the unit's economic minimum point.
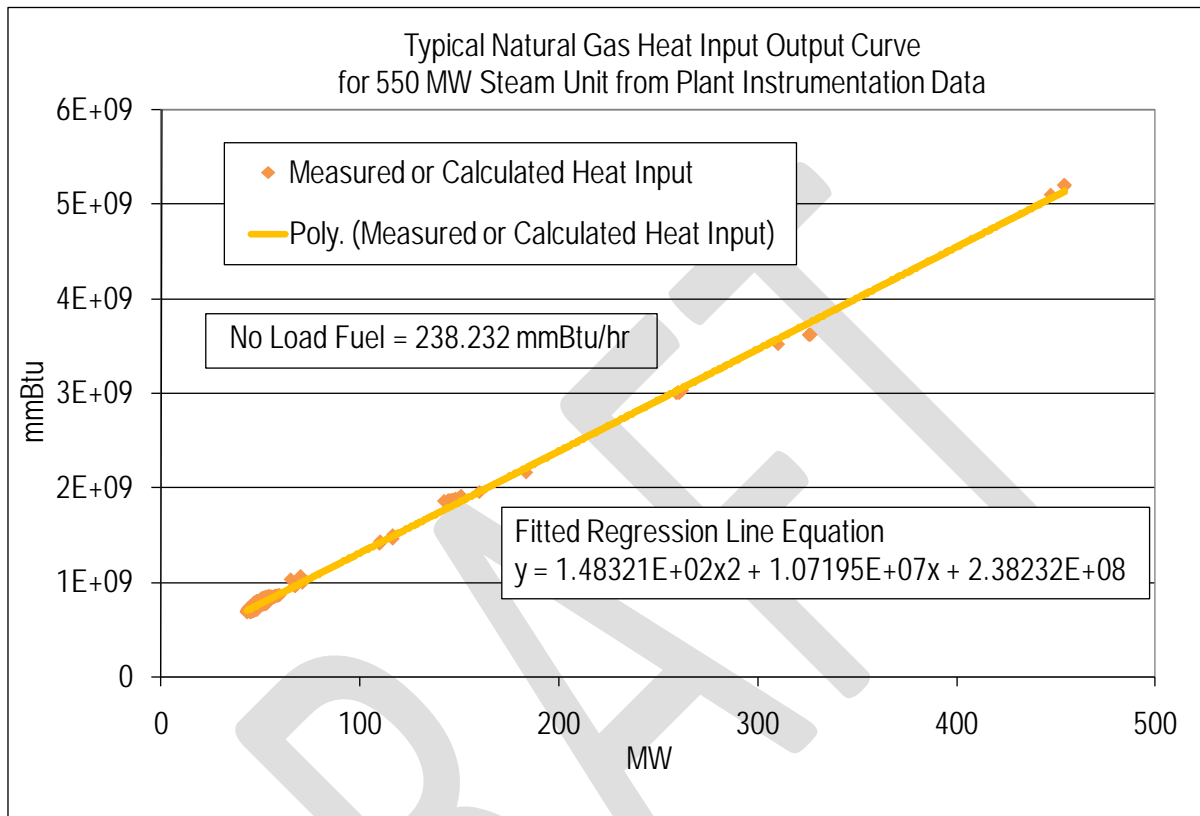
Attachment B: No Load Calculation Examples

The information included in this Attachment B provides guidance for calculating No-Load costs for various types of generating units.
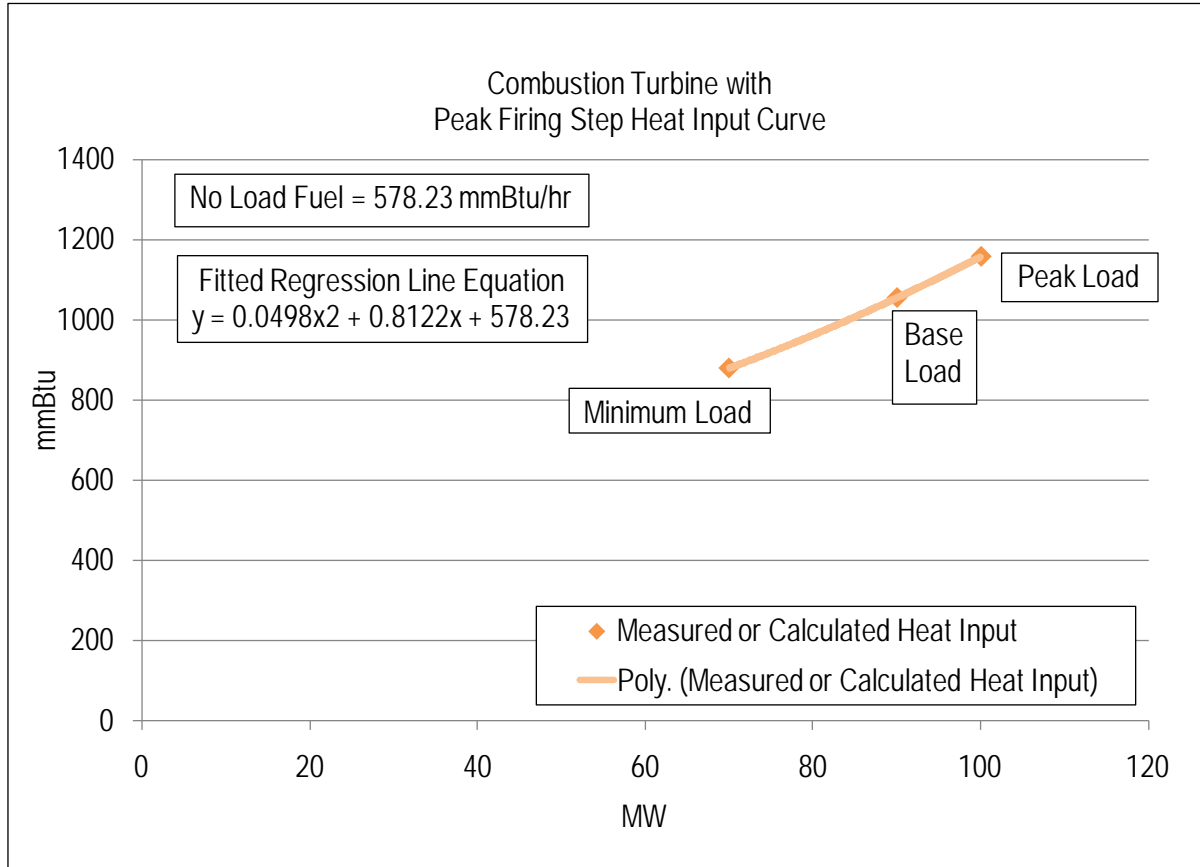
B.1 No-Load Fuel

All PJM members shall use no-load fuel to develop no-load costs for their units. Since generating units cannot normally be run stable at zero net output, the no-load fuel may be determined by:

- Collecting heat input values as a function of output and performing a regression analysis,

- Using heat input values as a function of output from empirical data and performing a regression analysis,

- Using the initial design heat input curve for an immature unit and performing a regression analysis,

- Or determining the theoretical value of fuel consumed at zero net output from test data.

An example of collecting heat input values as a function of output and performing a regression analysis on the data to obtain the no-load fuel for a typical fossil steam unit is shown below:

Typical Natural Gas Heat Input Output Curve for 550 MW Steam Unit from Plant Instrumentation Data

- Measured or Calculated Heat Input
- Poly. (Measured or Calculated Heat Input)

No Load Fuel = 238.232 mmBtu/hr

Fitted Regression Line Equation
$y = 1.48321E{+}02x^2 + 1.07195E{+}07x + 2.38232E{+}08$

An example of using the design heat input curve and performing a regression analysis to obtain the no-load fuel for a simple cycle combustion turbine with peak firing is shown below:

Combustion Turbine with
Peak Firing Step Heat Input Curve

No Load Fuel = 578.23 mmBtu/hr

Fitted Regression Line Equation
$y = 0.0498x^2 + 0.8122x + 578.23$

Peak Load

Base Load

Minimum Load

◆ Measured or Calculated Heat Input

—— Poly. (Measured or Calculated Heat Input)

mmBtu

MW

An example of using the design heat input curve and performing a regression analysis of the data to obtain the no-load fuel for a two on one combined cycle with duct burners is shown below:

2 on 1 Combined Cycle with Duct Burning Heat Input Curve

No Load Fuel = 312.36 mmBtu/hr

Fitted Regression Line Equation
$y = 0.0078x^2 + 4.5164x + 312.36$
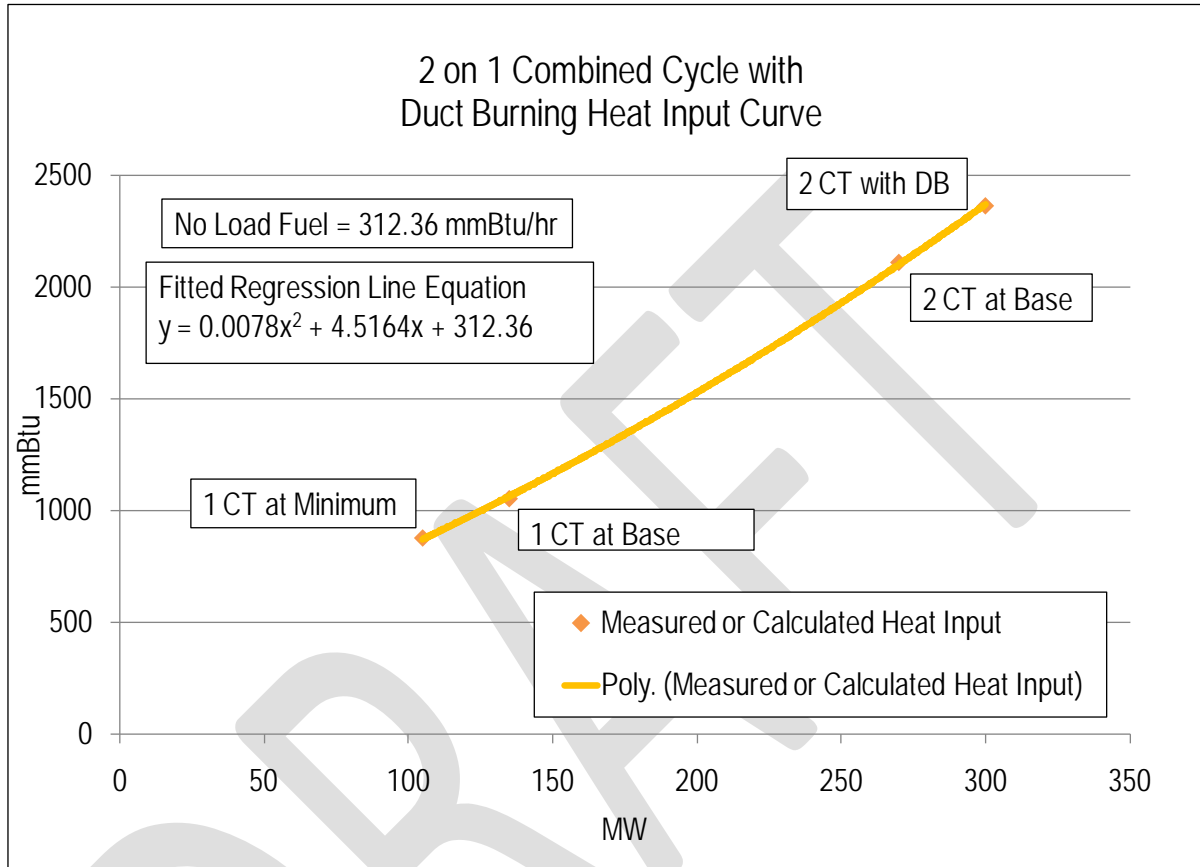
No-load fuel consumed shall be the theoretical value of fuel consumed at zero net output from test data or through regression analysis of the input-output curve. The minimum number of points to develop a heat input curve shall be 2 points for a dispatch able unit with a variable output and 1 point for a unit with a fixed output.
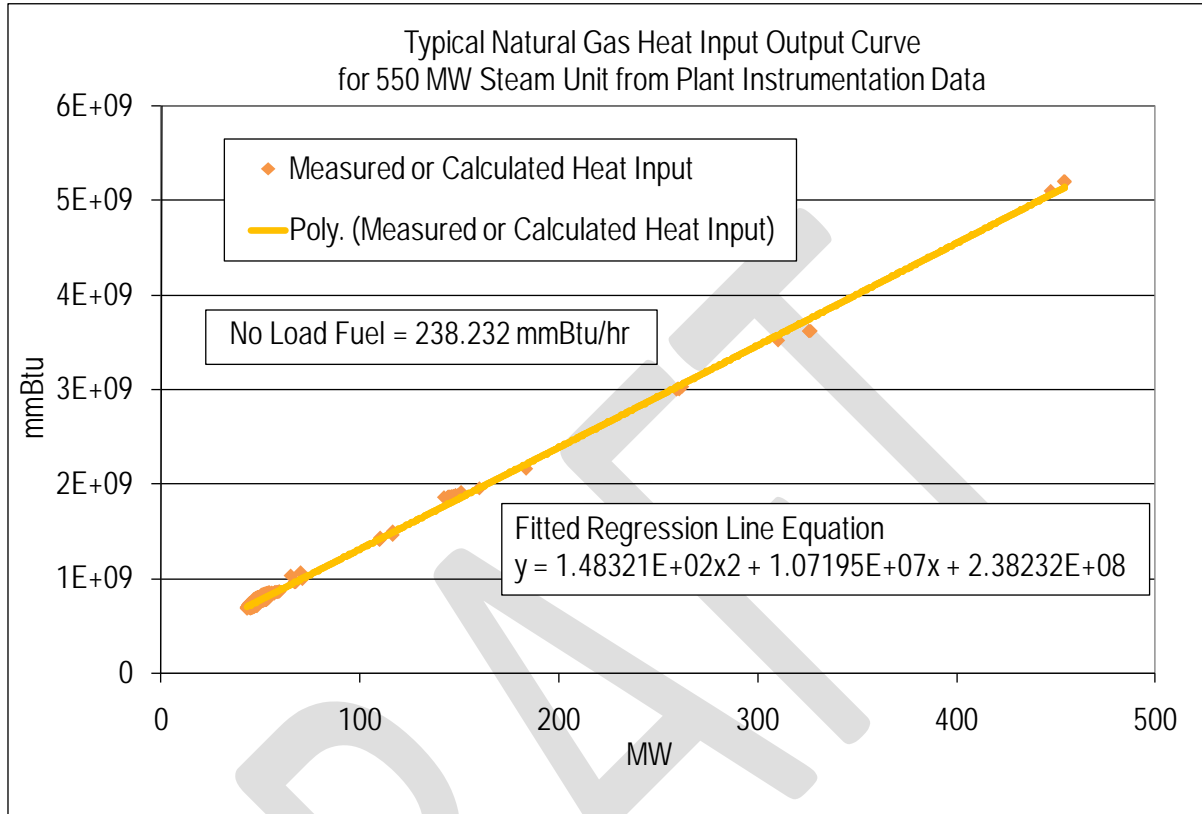
B.2 No-Load Cost Calculation

The initial estimate of a unit's **No-Load Cost ($/Hr)** is the No-Load fuel Cost multiplied by the performance factor, multiplied by the (Total Fuel-Related Cost (TFRC))

$$\text{No Load Cost}(\$ / \text{Hour}) =$$

$$(\text{No Load Fuel} * \text{Performance Factor} * \text{TFRC})$$
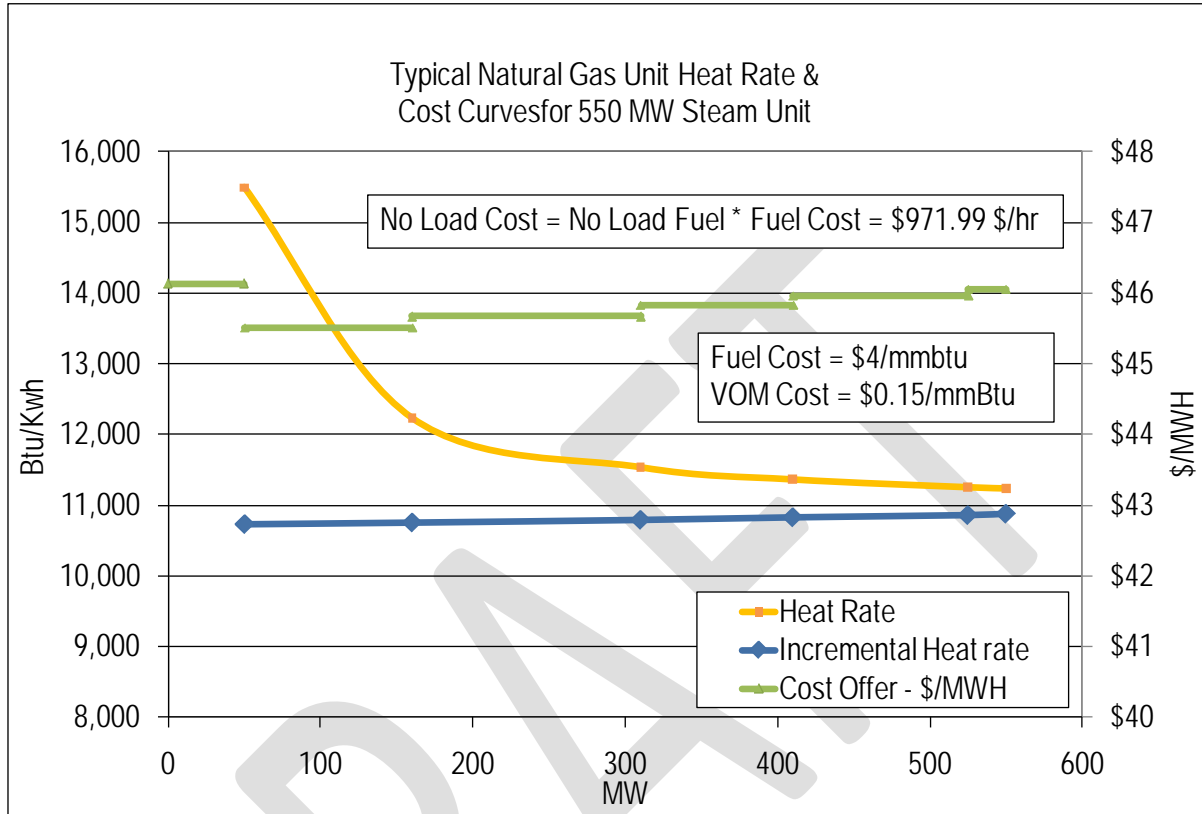
B.3 No-Load Cost Adjustments

The calculated no-load cost can be adjusted to allow for the first incremental point of the unit's generator offer curve to comply with PJM's monotonically increasing curve requirement.

An example of adjusting the no-load cost after calculation follows. Heat input values as a function of output was collected for a typical fossil steam and a regression analysis was performed to obtain the no-load.

**Typical Natural Gas Heat Input Output Curve
for 550 MW Steam Unit from Plant Instrumentation Data**

- ◆ Measured or Calculated Heat Input
- ── Poly. (Measured or Calculated Heat Input)

No Load Fuel = 238.232 mmBtu/hr

Fitted Regression Line Equation
$y = 1.48321E{+}02x^2 + 1.07195E{+}07x + 2.38232E{+}08$

(y-axis: mmBtu; x-axis: MW)

Once the No-Load Cost was calculated, the unit's cost curve was then developed. However due to the quality of the heat input data, the first increment of the cost offer was greater than the second increment.

Typical Natural Gas Unit Heat Rate & Cost Curvesfor 550 MW Steam Unit

No Load Cost = No Load Fuel * Fuel Cost = $971.99 $/hr

Fuel Cost = $4/mmbtu
VOM Cost = $0.15/mmBtu

Legend:
- Heat Rate
- Incremental Heat rate
- Cost Offer - $/MWH

X-axis: MW
Left Y-axis: Btu/Kwh
Right Y-axis: $/MWH

The No-Load cost was then raised until the first increment of the cost offer was less than or equal to the second increment, producing a monotonically increasing curve.

Typical Natural Gas Unit Heat Rate & Cost Curves for 550 MW Steam Unit

No Load Cost = No Load Fuel * Fuel Cost = $1007.76 $/hr

Fuel Cost = $4/mmbtu
VOM Cost = $0.15/mmBtu