4 August 2023

ENERGY BALANCING AND SETTLEMENT – VARIABLES

The Energy Balancing and Settlement variables are set according to the Pilbara Network Rules and methodology outlined in the Interim Energy Balancing and Settlement Procedure.

Rule	Variable	Value
231 (a)	Administered Price (AP)	$168.00 per MWh
231 (b)	Administered Penalty Price (APP)	$218.40 per MWh (130% of the AP)
233	Tolerance Margin	1.5%

Appendix 1 provides the methodology for the AP and APP (as provided in Appendix B of the Interim Energy Balancing and Settlement Procedure).

Appendix 2 provides the calculation of the AP and APP, including the inputs used in this calculation.

The values of the variables will be reviewed from time to time to update inputs such as the gas price and variable operating and maintenance cost. The values do not form part of the Interim Energy Balancing and Settlement Procedure.

Appendix 1: Methodology for Calculation of EBAS Administered Price

This appendix provides the methodology undertaken to calculate the Administered Price (AP) and Administered Penalty Price (APP) for energy balancing in accordance with Subchapter 8.3 of the Rules.

Basis of Methodology

Calculation of the AP is based on the industry standard concept of Short Run Marginal Cost of energy (SRMC). The SRMC, in $/MWh, is the cost of procuring an additional 1 MWh of energy from the most expensive generator in the power system (that is, the generator with the highest cost of generating electricity relative to all other generators in the system).

The SRMC consists of three main components:

1. Variable operating and maintenance costs, in $/MWh, specifically:
    a. labour and material costs associated with running the power station i.e. wages of operational personnel, water and other consumable materials not including fuel; and
    b. maintenance costs, commonly represented by the cost of starting the machine[1].
2. Fuel costs, including transport and commodity costs, in $/GJ; and
3. Fuel consumption rate, also known as heat rate, in GJ/MWh.

The variables comprising these components are typically assigned a probabilistic distribution and subjected to a Monte Carlo simulation to account for the uncertainty (risk) in the factors affecting the variables.

The Australian Energy Market Operator (AEMO) each year calculates and publishes the SRMC for the Wholesale Energy Market (WEM) in the South-West of Western Australia, as part of the procedure to set the price limits of the Short Term Energy Market.

[1] Maintenance cycles of synchronous generating machines are determined predominantly by the number of starts. More frequent starting brings forward maintenance cycles, increasing maintenance costs.

This EBAS Procedure uses the SRMC calculations published in the 2020-2021 version of AEMO's report[2] as a basis for the calculation of the Administered Price. The ISO deems this as a reasonable basis for the following reasons:

- AEMO's calculations use the Parkeston LM6000 aero-derivative gas turbine with a maximum unit capacity of 37 MW[3] as the basis for one of two price limits it calculates. The LM6000 is a popular generating machine commonly used in the NWIS.
- The mean and median nameplate capacity of utility-scale generating units in the NWIS are 40.9 MW and 43.2 MW respectively. This makes the 37 MW reference machine used in AEMO's calculations comparable in terms of average heat rate.
- The ISO deems the use of AEMO's calculations a prudent and efficient approach to fulfilling its obligations under Rule 231 while achieving the Pilbara electricity objective, avoiding the need for extended third-party consultation by utilising existing studies conducted in a similar technical and economic context.

The detailed calculation methodology is given in AEMO's report on the AEMO website. This EBAS Procedure uses the component results in Table 14 of the report to calculate the Administered Price and Administered Penalty Price.

Calculation – Use of Starting Costs

The methodology in AEMO's report bases the variable operating and maintenance (Variable O&M) costs entirely on the starting costs of the reference machines. This assumes that the generator must first be started to provide 1 MWh of additional energy.

This assumption is not appropriate for determination of the AP in the NWIS, since the AP is used to represent the cost of energy imbalances that generally arise from minor fluctuations in supply and demand. In other words, the AP is

[2] https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/wa_wem_consultation_documents/2020/2020-energy-price-limits/aemo-energy-price-limits-review-202021-final-report-public.pdf?la=en
[3] Table 1: Candidate OCGT units for setting upper Energy Price Limits, AEMO Energy Price Limits Review 2020-2021

most commonly applied to energy imbalances that occur under normal operation of the system when generators are already running.

Rule 231 recognises that persistent energy imbalances of one balancing nominee may cause an unrelated generating unit to be started, and it does so by implementing a penalty price that applies to imbalances outside a tolerance range (the Balancing Tolerance Quantities defined in Rule 233).

Consequently, only the fuel cost and heat rate components are used to calculate the AP for the NWIS. The Variable O&M component is also used to calculate the penalty price uplift of 130%.

Calculation – Administered Price

The formula for determining the AP is given as

$$AP\ (\$/MWh) = Heat\ Rate\ (GJ/MWh) \times Unit\ Fuel\ Cost\ (\$/GJ)$$

Calculation – Administered Penalty Price

The Administered Penalty Price (APP) is an uplift of 130% on the AP.

In other words, the APP is given by:

$$transitional\ APP = 1.3 \times AP$$

As discussed above, the APP must consider the starting costs of the representative generating unit. Using AEMO's report, the uplift percentage of 130% has been calculated by considering the Variable O&M cost component of AEMO's SRMC calculation.

Appendix 2: Calculation of EBAS Administered Price

Calculation – Administered Price

The formula for determining the AP is given as

$$AP\ (\$/MWh) = Heat\ Rate\ (GJ/MWh) \times Unit\ Fuel\ Cost\ (\$/GJ)$$

The heat rate is taken from Table 14 of AEMO's report, equal to the "Mean Heat Rate" of 15.31 GJ/MWh.

The unit fuel cost, which includes the gas transport cost, is taken as a range of 7.00 to 11.00 $/GJ.

The AP is then given in a range as shown in Table 1.

Table 1: Administered Price range

Price Point	Heat Rate (GJ/MWh)	Unit Fuel Cost ($/GJ)	Administered Price ($/MWh)	Administered Price (c/kWh)
Low	15.31	7.00	107.17	10.717
Mean	15.31	9.00	137.79	13.779
High	15.31	11.00	168.41	16.841

Calculation – Administered Penalty Price

The Administered Penalty Price (APP) is an uplift of 130% on the AP.

In other words, the APP is given by

$$transitional\ APP = 1.3 \times AP$$

The APP must consider the starting costs of the representative generating unit. Using AEMO's report, the uplift percentage of 130% has been calculated by considering the Variable O&M cost component of AEMO's SRMC calculation.

From Table 1, the APP range is given in Table 2.

Table 2: Administered Penalty Price range

Price Point	Administered Price ($/MWh)	Uplift %	Administered Penalty Price ($/MWh)
Low	107.17	130%	139.32
Mean	137.79	130%	179.13
High	168.41	130%	218.93

Using Table 14 of the AEMO report and considering the Variable O&M cost component, the comparison APP is given by

$$APP_{comp.} = Variable\ O\&M\ (\$/MWh) + Heat\ Rate\ (GJ/MWh) \times Unit\ Fuel\ Cost\ (\$/GJ)$$

The value for Variable O&M cost in Table 14 of the AEMO report is 50.55 $/MWh.

The comparison APP and comparison uplift percentage is then given in Table.

Table 3: Comparison APP and uplift percentage

Price Point	Administered Price ($/MWh)	Comparison APP ($/MWh)	Comparison Uplift %
Low	107.17	157.72	147%
Mean	137.79	188.34	137%
High	168.41	218.96	130%

Results – Selected AP and APP

The selected AP and APP are given in Table 4.

Table 4: Administered Price and Administered Penalty Price

Unit Fuel Cost ($/GJ)	Administered Price ($/MWh)	APP Uplift %	Administered Penalty Price ($/MWh)
11.00	168.00	130%	218.40