Balancing Submission Guideline - DRAFT

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WESTERN AUSTRALIA

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1 Introduction

The Wholesale Electricity Market in the Western Australian South West Interconnected System operates under the *Electricity Industry Act 2004, Electricity Industry (Wholesale Electricity Market) Regulations 2004,* and *Wholesale Electricity Market Rules*[1].

Market Generators registered with the Australian Energy Market Operator (**AEMO**) make price and quantity offers into the Balancing Market, a component of the Wholesale Electricity Market (WEM), to supply electricity for each 30 minute Trading Interval.[2] These offers are called Balancing Submissions. Market Generators are primarily selected to supply electricity based on the price competitiveness of their Balancing Submissions.

Market Rules require Market Generators to price at or below their short run marginal cost (**SRMC**) when such behaviour relates to market power. Key amongst these is Rule 7A.2.17, which states:

> Subject to clauses 7A.2.3, 7A.2.9(c) and 7A.3.5, a Market Participant must not, for any Trading Interval, offer prices in its Balancing Submission in excess of the Market Participant's reasonable expectation of the short run marginal cost of generating the relevant electricity by the Balancing Facility, when such behaviour relates to market power.

1.1 Purpose of this Guideline

The Economic Regulation Authority (**ERA**) has responsibility for monitoring compliance with the Market Rules and investigating potential breaches of the Market Rules in the WEM.[3] The ERA aims to clarify Market Participants bidding obligations under the Market Rules.

A number of the terms used in Rule 7A.2.17 are not defined in the Market Rules and open to different interpretation.

The purpose of this Guideline is to explain how the ERA interprets these undefined terms. It also provides guidance on which costs the ERA considers may form part of a Market Participant's SRMC.

The Guideline is not binding on the ERA. It is intended only to provide guidance to Market Participants on the ERA's current approach to monitoring and compliance with Rule 7A.2.17. Market Participants should seek their own advice on these issues. Whether a Market Participant contravenes Rule 7A.2.17 will ultimately depend on the particular facts of the situation.

The ERA is issuing this Guideline to explain how it will approach the interpretation of the undefined terms used in Rule 7A.2.17. A shared understanding of the ERA's approach to interpreting the terms used in Rule 7A.2.17 will support greater confidence in the market and more efficient market outcomes.

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1 In this guideline these are referred to as the 'Market Rules', with individual rules preceded by the word 'Rule' (for example Rule 7A.2.17).

2 Capitalised terms in this guideline have the same meaning as those terms in the Market Rules unless stated otherwise.

3 Rule 2.2A, *Wholesale Electricity Market Rules.*

2 Market Rule 7A.2.17

Rule 7A.2.17 states:

> Subject to clauses 7A.2.3, 7A.2.9(c) and 7A.3.5, a Market Participant must not, for any Trading Interval, offer prices in its Balancing Submission in excess of the Market Participant's reasonable expectation of the short run marginal cost of generating the relevant electricity by the Balancing Facility, when such behaviour relates to market power.

The terms 'reasonable expectation', 'short-run marginal cost', 'relates to' and 'market power', are all used in Rule 7A.2.17 but not defined in the Market Rules. This can create uncertainty in interpreting these terms.

The ERA considers that Rule 7A.2.17 should be read with regard to the WEM objectives. These objectives are contained in both Rule 1.2.1 and in Section 122 of the *Electricity Industry Act 2004*[4].

Rule 1.2.1 states:

> 1.2.1. The objectives of the market are:
>
> (a) to promote the economically efficient, safe and reliable production and supply of electricity and electricity related services in the South West interconnected system;
>
> (b) to encourage competition among generators and retailers in the South West interconnected system, including by facilitating efficient entry of new competitors;
>
> (c) to avoid discrimination in that market against particular energy options and technologies, including sustainable energy options and technologies such as those that make use of renewable resources or that reduce overall greenhouse gas emissions;
>
> (d) to minimise the long-term cost of electricity supplied to customers from the South West interconnected system; and
>
> (e) to encourage the taking of measures to manage the amount of electricity used and when it is used.

Having regard to the market objectives, the ERA considers that Rule 7A.2.17 is in place to promote efficiency and to encourage competition among Market Participants. The words in Rule 7A.2.17 should be read with this purpose in mind.

[4] *Electricity Industry Act 2004* (WA).

3 Bidding at Short Run Marginal Cost

3.1 Definitions

SRMC is the increase in total cost that arises from a unit increase in output. The theoretical definition can be expressed as:

$$C'(Q) = \frac{\Delta C}{\Delta Q}, \qquad Q \geq 0$$

where SRMC (denoted C') is a function of the plant's output (Q). That is, C' is the rate of change of cost (C) with respect to quantity (Q), for a small change in output. This Guideline draws on this well-established economic definition of SRMC.

Input costs can be categorised into 3 broad types: **Variable Costs**, **Avoidable Fixed Costs** (AFCs) and **Fixed Costs** (see table below).

The economic definition only considers Variable Costs (such as fuel, water and other operating costs including chemical inputs, and wear and tear on plant and equipment) and excludes both AFCs and Fixed Costs.

Variable Costs are costs that change with the level of production, and could be increasing or decreasing in a continuous or step-wise fashion. The ERA's definition of Average Variable Cost (AVC) is the sum of all variable costs and AFCs, averaged by the quantity of electricity generated.

A generator incurs AFCs if it produces electricity, but these costs do not vary as production moves up or down.[5] The most relevant example of an AFC in electricity generation is start-up costs.

The capital cost of building a generator, fixed operating and maintenance costs for a generator and transmission facilities, etc are considered fixed costs. They are also termed unavoidable fixed costs and generators must not include these in calculating their SRMC or AVC.

Table 1: Comparison of Valid Costs

Input Cost Component	Is it a valid cost?	
	SRMC	AVC
Variable Costs	Yes	Yes
- Fuel, Carbon		
Avoidable Fixed Costs	No	Yes
- Start-up Costs		
Fixed Costs	No	No

[5] Economic Regulation Authority, Portfolio Short Run Marginal Cost of Electricity Supply in Half Hour Trading Intervals: Technical Paper, 11 January 2008, http://www.erawa.com.au/cproot/6317/2/20080111%20Short%20Run%20Marginal%20Cost%20-%20Technical%20Paper.pdf, p.10.

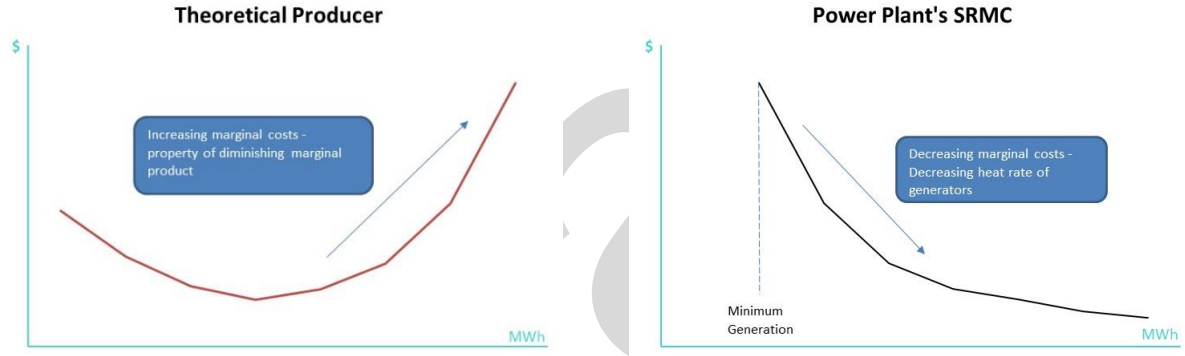
SRMC is a forward looking concept, with costs previously incurred and now unavoidable considered sunk and not relevant to the generation decision. This means forecasting and judgement are required in making estimates of a firm's SRMC for the period in question.

3.2 Peculiarities of electricity generation and Balancing Submissions

Not only is there more than one way to define SRMC, but the adoption of the economic definition of SRMC in examining a Market Participant's behaviour under Rule 7A.2.17 could cause problems for a generator operating in the WEM.

Firstly, it is impossible for a generator to increase production by 'one more unit' from its zero generation. Thermal generators have a 'minimum generation' level, below which production is not stable. Hence, costs between zero and the minimum generation level must be averaged.

Secondly, producers in most industries typically face U shaped cost curves where marginal costs fall initially then begin increasing with increasing output as shown in the chart below.



However, electricity generators typically become more efficient as they increase production from minimum generation to maximum generation. This is a result of the decreasing heat rates of generators. A generator's average heat rate is the amount of fuel required to generate a unit of electricity, and a lower heat rate means lower fuel costs.

Differentiation between average heat rate and marginal heat rate is crucial when determining balancing market price and quantity offers, as the marginal heat rate is relevant to the calculation of SRMC (average heat rates are used to determine marginal heat rates as shown in the examples to follow). Average heat rates are used in the calculation of AVC.

As many other costs of an electricity generator are linear, the actual SRMC of the generator falls as production increases. A generator's SRMC will be less than its AVC across much, possibly all, production levels. A generator will lose money supplying electricity unless the Balancing Price received equals or exceeds the generator's AVC.

Strict pricing at a generator's SRMC can lead to a generator making a loss in the Balancing Market, which is not sustainable in the long term and affects whether optimal investment in the WEM is achieved. In these circumstances, the ERA considers that pricing at AVC is a valid approach to pricing as the prices offered are likely to reflect the generator's reasonable expectation of the costs of generating the relevant electricity and avoid making short-run losses in generating the relevant electricity.

Further, a generator is not considered able to offer prices exactly at SRMC for each production level because it must offer prices in a monotonically upwards manner (that is each successive tranche bid into the market must be at a higher price than the last), otherwise notionally higher-output tranches will be dispatched first.

Due to these peculiarities of electricity generation, when a generator offers prices above its reasonable expectation of its SRMC, but not exceeding its AVC, then the ERA considers that the behaviour may not be related to market power.

4 Interpretation of undefined terms in Market Rule 7A.2.17

This section provides guidance on the interpretation of undefined terms in Rule 7A.2.17. As a general principle, words should be given their ordinary meaning within the context in which they appear in the Market Rules.

4.1 Reasonable expectation

An expectation is a strong belief that something will be the case or happen in the future. It could also be a forecast. For an expectation to be reasonable, the expectation must have some basis above guessing or speculation. It must also be viewed in the context of the information available to the generator. The forecast costs of a Market Participant should be more informed than the forecast costs from someone not familiar with the market. Therefore, a Market Generator is expected to have a good understanding of its costs, and of the market more broadly.

Market Participants are not required to have perfect foresight in forming a reasonable expectation. A Market Participant's reasonable expectation of its SRMC at the time of making its Balancing Submission for a particular Trading Interval may differ from the eventual SRMC. The important factor is that the Market Participant's forecasts were reasonable.

Essentially, the test is what a reasonable Market Generator would have expected with reference to the circumstances known to that generator at the time.

4.2 Market power

Market power can be defined as the ability to influence price and benefit financially from this ability. An entity with market power can usually operate with little or no constraint from competitors, suppliers, customers or new entry into the market. A Market Participant with market power is able to, amongst other things, make decisions about pricing independent of the market or market forces.

Market power may also be evidenced through decisions on quantity, e.g. where a Market Participant withholds energy from the market. This is because withholding can affect the Balancing Price.[6] Withholding can be either physical (by taking a generator offline) or economic (by raising the price at which it offers its output above its SRMC and up to the market price cap). In many short-term electricity markets, demand is completely inelastic over the relevant trading interval. In this situation, withholding usually results in an increase in price without a reduction in quantity consumed.

Several elements in Rule 7A.2.17 affect the interpretation of market power:

(a) there is no express requirement that market power be significant or sustained;

[6] Biggar, D, The Theory and Practice of the Exercise of Market Power in the Australian NEM https://www.aer.gov.au/system/files/AER%20Attachment%201%20-%20Darryl%20Biggar%20paper%20-%20The%20theory%20and%20practice%20of%20the%20exercise%20of%20marlet%20power%20in%20the%20Australian%20NEM%20-%2026%20April%20%202011.pdf

(b) the provision is capable of being mobilised in respect of 'any Trading Interval', in connection with the generation of the 'relevant electricity'; and

(c) it links market power to prices above the generator's reasonable expectation of its SRMC.

The first element (a) indicates that **any** market power is of concern under Rule 7A.2.17.

In energy-only markets such as the National Electricity Market, some degree of temporary market power is necessary or desirable for generators as it signals the need for new capital investment in the market. This is because there is no separate capacity market and no explicit capacity payment as is present in the WEM.

There is less need to tolerate market power in the WEM. Prices in the separate capacity market provide a signal as to the adequacy of generation capacity and the need for investment.

Whether or not market power exists in the context of Rule 7A.2.17, the ERA considers that the timeframe over which the assessment is made is no longer than is necessary for trading to take place. In the WEM, this is a single Trading Interval. Pricing for a single Trading Interval can be enough to trigger Rule 7A.2.17.

4.3 When pricing 'Relates to' market power

A causal link needs to be made between a Market Participant's market power and its pricing behaviour to establish that a Market Participant's behaviour is related to market power.

The ERA would consider whether or not a Market Participant would offer the same prices during a given time period both with and without market power. The pricing behaviour may relate to market power where the prices offered in a Balancing Submission:

(a) differ from the Market Participant's standard pricing behaviour when it did not have market power; and / or

(b) increase the Market Participant's profits when it has market power relative to its standard pricing behaviour without market power. [7]

Ultimately, whether a Market Participant has market power and its behaviour relates to that market power will need to be determined taking into account all of the relevant circumstances.

[7] There could be circumstances in which a generator would make exactly the same profits. It could be indifferent between being dispatched or not if its capital costs are covered in the capacity market and it bids into the market at its AVC.

5 Worked examples

Three examples are provided to assist Market Participants' understanding of the ERA's interpretation of Rule 7A.2.17. In each example the ERA has assumed that the generator has market power.

5.1 Example 1

Assume a coal generator has minimum generation output level of 20MW, it is running and has heat rates, cost and input variables to produces 40MW[8] as shown in the tables below. Whether the input is considered part of SRMC or AVC is also included:

Input Cost Component	Cost $/MWh @40MW SRMC (AVC)	SRMC	AVC
Operations and Maintenance[9]	9.00	N	Y
Ancillary expenses[9]	2.00	N	Y
Shared services[9]	1.00	N	Y
Mill maintenance[9]	3.00	N	Y
Fuel cost @ coal price of $3/GJ	43.50 (54.00)	Y	Y
Incremental O&M	5.00	Y	N
SRMC/AVC	48.50 (69.00)		

Output (MW)	Average Heat Rate (GJ/MWh)
20	19.00
35	18.50
40	18.00

To calculate fuel cost for SRMC, multiply the marginal heat rate at 40MW (14.5GJ/MWh – details in Box 1 overleaf) by the coal price of $3/GJ, which gives a fuel cost of $43.50/MWh.

[8] This is equivalent to 20MWh in a half hour trading interval. In the MHR equation, a factor of 0.5 works its way out to give the same answer. In the other examples, AVC calculations are in MWh and hence a factor of 0.5 is applied to convert figures from MW to MWh.

[9] For this example we assume these costs are incurred with generating the electricity but do not change with production levels and are therefore considered AFCs.

The only other allowable Variable Cost which can be added to fuel cost to make up the SRMC in the table above is the Incremental Operations and Maintenance cost of $5/MWh which gives a SRMC of $48.50/MWh.

AFCs form part of the Average Variable Cost. In practice these components are calculated differently from the SRMC figures as they are averaged or spread over total generation (from minimum generation to the production level) as opposed to using the SRMC equivalent which is determined at the margin for a small output change. Also note the differentiation of marginal and average heat rates. In the calculation of SRMC above, average heat rates were used to calculate the marginal heat rate at production of 40MW.

Box 1

The generator's Marginal Heat Rate is calculated as follows:

$$MHR = \frac{\left(40MW * HR(40MW) - 35MW * HR(35MW)\right)}{(40MW - 35MW)}$$

$$= \frac{(40MW * 18GJ/MWh - 35MW * 18.5GJ/MWh)}{(5MW)}$$

$$= \frac{(720GJ - 647.5GJ)}{(5MW)}$$

$$= 14.5GJ/MWh$$

In calculating the AVC, the fuel cost is the average heat rate at 40MW (18GJ/MWh) multiplied by the coal price of $3/GJ, which is $54/MWh.

The allowable components in the table above to be added to the fuel cost includes Operations and Maintenance ($9/MWh), Ancillary expenses ($2/MWh), Shared Services ($1/MWh), and Mill Maintenance ($3/MWh). The total AVC is calculated to be $69/MWh.

In this example, the generator would make a loss if it bid at SRMC and the Balancing Price was below its AVC, given a generator's breakeven price is its AVC.

The ERA considers that in this example the generator could provide price and quantity offers at $69/MWh without contravening Rule 7A.2.17.

5.2 Example 2

Assume a gas powered unit is running and is expected to continue running at 250MW with the following input costs and (average) heat rates:

Output (MW)	Heat Rate (GJ/MWh)
105	8.310
135	7.883
200	7.680
250	7.625
270	7.779
300	7.897

Variable Operating and Maintenance	$5/MWh
AFCs	$100/hr
Gas Price	$6/GJ
Start-up Costs	$2,000

The AVC is calculated by multiplying the heat rate at 250MW by the fuel price and adding the Operating and Maintenance Costs and average per MW avoidable fixed costs. Start-up costs are not included as the plant is already running. The avoidable fixed cost figure is converted to a per MW figure by dividing by the generator's power output, as follows:

$$AVC = 7.62 * 6 + 5 + 100/250$$

$$AVC = \$51.15/MWh$$

This figure would be considered the upper limit of this generator's Balancing Submission bids.

To calculate the SRMC, it is necessary to convert the average heat rates to marginal heat rates using the formula as in Example 1:

$$MHR = \frac{\left(250MW * HR(250MW) - 200MW * HR(200MW)\right)}{(250MW - 200MW)}$$

$$= \frac{(250MW * 7.625GJ/MWh - 200MW * 7.68GJ/MWh)}{(50MW)}$$

$$= \frac{(1{,}906.18GJ - 1{,}536.00GJ)}{(50MW)}$$

$$= 7.40GJ/MWh$$

As in the Example 1, the fuel cost is calculated by multiplying the marginal heat rate by the gas price, which equals $44.42/MWh.

Adding the Variable Operating and Maintenance costs of $5/MWh gives a SRMC of $49.42/MWh.

In this example, the generator would make a loss if it bid at SRMC and the Balancing Price was below its AVC, given a generator's breakeven price is its AVC.

Accordingly, the ERA considers that in this example the generator could provide price and quantity offers at its average variable cost of $51.15/MWh without contravening Rule 7A.2.17.

5.3 Example 3

This example is based on the plant with the same costs and heat rates as Example 2 above but which is not currently generating. The plant is expected to start-up and run for 12 Trading Intervals at 200MW.

At 200MW, the heat rate is 7.58GJ/MWh which can be used to calculate the marginal heat rate as follows:

$$MHR = \frac{\left(200MW * HR(200MW) - 105MW * HR(105MW)\right)}{(200MW - 105MW)}$$

$$= \frac{(200MW * 7.58GJ/MWh - 105MW * 8.31GJ/MWh)}{(95MW)}$$

$$= \frac{(1{,}516.96GJ - 872.58GJ)}{(95MW)}$$

$$= 6.78GJ/MWh$$

Note the average heat rate at the minimum generation level of 105MW is used as the generator is starting up from zero.

Multiplying the marginal heat rate by the fuel cost (6.78*6) produces a figure of $40.70/MWh. SRMC is then calculated by adding Variable Operation and Maintenance costs of $5/MWh resulting in a SRMC of $45.70/MWh.

Start-up costs are not included as part of SRMC so in this case the generator would be making a loss unless the Balancing Price was equal to its AVC which includes start-up costs and other AFCs. Start-up costs are averaged over an output factor taken to be the expected generation level (200MW in this case) multiplied by the 12 expected trading intervals (multiplied by 0.5 to convert to hours). AFCs are averaged over the expected generation level. This gives an AVC of:

$$AVC = 7.58 * 6 + 5 + \frac{100}{200} + \frac{2{,}000}{12 * 0.5 * 200}$$

$$AVC = \$52.68/\text{MWh}$$

For this example, the generator could submit bids in the Balancing Market up to its AVC of $52.68 without contravening Rule 7A.2.17.