



REVIEW OF THE LONG RUN MARGINAL COST (LRMC) PARAMETERS FOR SETTING THE VESTING CONTRACT PRICE FOR THE PERIOD 1 JANUARY 2011 TO 31 DECEMBER 2012

DRAFT DETERMINATION PAPER

Closing date for submissions of comments and feedback: 14 September 2010

Note: There will be no extension of deadline beyond 14 September 2010, 5 pm

25 AUGUST 2010

ENERGY MARKET AUTHORITY
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1. INTRODUCTION

1.1. The Energy Market Authority (“EMA”) implemented vesting contracts on 1 January 2004. The objective of the vesting regime is to control the exercise of market power by the generation companies (“gencos”) and promote efficiency and competition in the electricity market. The vesting contracts commit the gencos to sell a specified amount of electricity (viz, the vesting contract level) at a specified price (viz. the vesting contract price).

1.2. The vesting contract price is set taking into account both the long run marginal cost (“LRMC”) of the most efficient technology that accounts for at least 25% of our system demand and the policy objective to promote efficiency and competition in the electricity market for the benefit of consumers. The plant to be used for this purpose is to be based on a theoretical generation station with the most economic plant portfolio (for existing CCGT technology, this consists of 2 to 4 units of 370MW plants).

1.3. EMA conducts a biennial review of the LRMC parameters used to set the vesting contract price or at other times where it considers necessary. The procedures for determining the vesting price can be found in the document “EMA’s Procedures for Calculating the Components of the Vesting Contracts (Version 1.5)” (“Vesting Contract Procedures”). EMA has appointed PA Consulting Group Pte Ltd (“PA Consulting”) to assist in the review of the LRMC parameters for setting the vesting contract price for the period 1 January 2011 to 31 December 2012.

1.4. This report summarises EMA’s determination of the LRMC parameters used to set the vesting contract price for the period **1 January 2011 to 31 December 2012** taking into consideration the recommendations of its consultant, PA Consulting.

2. CONSULTATION PROCESS

1.5. EMA invites comments and feedback to the draft determination paper and PA Consulting's draft report. Please submit all written feedback to Ms Rachel Su Huifen (su_huifen@ema.gov.sg) or Ms Leow Rui Ping (leow_rui_ping@ema.gov.sg) by 14 September 2010 (5pm).

1.6. Alternatively, you may send the submissions by post/fax to:

Market Development and Surveillance Department
Regulation Division
Energy Market Authority
991G Alexandra Road, #01-29
Singapore 119975

Fax: (65) 6 835 8020

1.7. Please note that any anonymous submissions will not be considered. EMA reserves the right to make public all or parts of any written submissions made in response to this Consultation Paper and to disclose the identity of the source. Any part of the submission, which is considered by respondents to be confidential, should be clearly marked and placed as an annex. EMA will take this into account regarding disclosure of the information submitted.

1.8. The timeline for the consultation process is shown in Table 1 below:

Table 1: Consultation Process

Date	Event
25 August 2010	EMA publishes Draft Determination paper and PA Consulting's Draft Report
27 August 2010	Plenary session (Industry and Consumers) with PA Consulting
14 September 2010 (5pm)	Due date for submission of comments on the Draft Determination paper and PA Consulting's Draft Report
21 September 2010	EMA circulates to the industry PA Consulting's Final Report and response to industry's comments
28 September 2010	EMA makes its Final Determination to the industry

3. BASE MONTH

3.1 EMA has adopted May 2010 as the "Base Month" for the determination of the LRMC parameters for setting the vesting contract price for the period 1 January 2011 to 31 December 2012.

3.2 During the mid-term review of the review of the LRMC parameters for setting the vesting contract price for the period 1 January 2010 to 31 December 2010, EMA had identified certain base parameters which can be very volatile. As such, to minimise the volatility and to avoid the contention of the choice of the base month, EMA had determined that data for the following "selected base parameters" would be based on the three months leading to the base month:

- a. Exchange rate to convert the costs denominated in foreign currencies into Singapore Dollars;
- b. Diesel price to calculate cost of carrying fuel;
- c. Risk-free rate;
- d. Debt premium to calculate cost of debt;
- e. Consumer Price Index;
- f. Domestic Supply Price Index; and
- g. Imported Iron & Steel Index.

3.3 For the purpose of reducing volatility of results, the data used in the estimation of the selected base parameters have been averaged over a three month period leading up to the "base month" for this review.

4. REVIEW OF TECHNICAL PARAMETERS

Generating Technology

4.1 Currently, the most efficient technology that accounts for at least 25% of the system demand in Singapore is the 'F' class technology of the combined cycle gas turbine ("CCGT"). In the determination of the vesting contract price, EMA considers a new entrant will have a plant size of two to four units of 370 MW CCGTs. The costs of common items such as land, site development and basic infrastructure to support the operation of the CCGTs would be shared between the two units.

Capacity per generating unit

4.2 Taking into account of degradation due to fouling, erosion and material losses in the turbine section; local air temperature; and local cooling water temperature, the achievable effective plant capacity in Singapore for a 'F' class CCGT would be **382 MW**.

HHV Heat Rate

4.3 The HHV heat rate for the proxy plant is **6,976** Btu/kWh. This takes into account the effects of degradation, local air temperature, local cooling water temperature and part load factor.

Build Duration

4.4 The build duration of the proxy plant is taken to be **30 months**.

Economic Lifetime

4.5 The economic lifetime of the proxy plant based on PA's modelling is **24 years**.

Plant Load Factor

4.6 The plant load factor is set at **74.9%**, based on the actual performance of the existing 'F' class CCGTs in operation in the system i.e. Senoko Energy's CCGT units 3 to 5, PowerSeraya's CCGT units 1 to 2, Tuas Power Generation's CCGT units 1 to 4 from June 2009 to May 2010 and checked to be achievable for 2011 and 2012. Station load has been subtracted when determining the plant load factor.

Investment Cost

Capital Cost

4.7 The capital cost includes the cost of purchasing the plant and all associated equipment, including the cost of delivery of the plant in a state suitable for installation in Singapore.

4.8 The total capital cost is **\$586.2 million** for one unit of 'F' class CCGT, comprising of:

- | | |
|-----------------------------------------------------------------|-----------------|
| a. Turnkey Engineering, Procurement and Construction (EPC) cost | \$577.7 million |
| b. Discounted through-life capital cost | \$8.5 million |

4.9 Capital cost includes (i) facility costs (ancillary buildings, demineralisation plant, sea water intake/outfall structures, constructing the jetty for emergency fuel unloading facility and gas receiving facilities) classified under land and site preparation cost in previous reviews, (ii) emergency fuel facilities classified under land and site preparation cost in previous reviews, (iii) civil works for the plans, erection and assembly, detailed engineering and start-up costs, and contractor soft costs classified under connection cost in previous reviews and (iv) discounted through life capital cost classified under miscellaneous cost in previous reviews.

Land and Site Preparation Cost

4.10 The total land and site preparation cost for one unit of 'F' class CCGT is **\$13.7 million**, comprising of:

- | | |
|-----------------------------------------|-----------------|
| a. Land lease cost and water front fees | \$12.95 million |
| b. Land preparation cost | \$0.75 million |

4.11 The land and site preparation cost excludes (i) facility costs (ancillary buildings, demineralisation plant, sea water intake/outfall structures, constructing the jetty for emergency fuel unloading facility and gas receiving facilities) and (ii) emergency fuel facilities. These costs have been included under capital cost for the current review.

Connection Cost

4.12 The total connection cost for one unit of 'F' class CCGT is **\$38.2 million**, comprising of:

- a. Electrical connection cost \$31.5 million
Standard connection charge to SPPG (\$50,000 per MW), switchgear GIS and underground cable
- b. Gas connection costs \$6.7 million

4.13 Connection cost excludes civil works for the plans, erection and assembly, detailed engineering and start-up costs. These costs have been included under capital cost for the current review.

Miscellaneous costs

4.14 The total miscellaneous cost for one unit of 'F' class CCGT is **\$104.8 million**. This cost consists of:

- a. Owner's costs after financial closure \$67.8 million
owner's engineering; owner's "minor items"; initial spares; start-up costs and construction related insurance
- b. Owner's costs prior to financial closure \$37.0 million
Permits, licenses, fees; legal and financial advice and costs; and owner's engineering and in-house costs

4.15 Miscellaneous cost excludes discounted through life capital cost. These costs have been included under capital cost for the current review.

Non-fuel Operation Costs

Fixed Annual Running Cost

4.16 The fixed annual running cost includes the fixed operating and overhead costs that are incurred in having the plant available for supplying energy and reserves but are not dependent on the quantity of energy supplied.

4.17 The fixed annual running cost for one unit of 'F' class CCGT is **\$22.292 million** per annum, comprising of:

a. Manpower and allowance for head office services	\$2.625 million
b. Emergency fuel usage	\$0.75 million
c. Fixed maintenance and other fixed operations <i>Fixed maintenance and other fixed operations; starts impact on turbine maintenance; and distillate usage on turbine maintenance.</i>	\$8.918 million
d. Working Capital	\$6.549 million
e. Insurance, property tax and EMA license fee	\$3.45 million

Variable Non-Fuel Cost

4.18 The variable non-fuel cost includes any costs, other than fuel costs, that vary with the level of energy output. The variable non-fuel cost is estimated at **\$6.40/MWh** for one unit of 'F' class CCGT, comprising of:

a. LTSA for maintenance of Gas Turbine and Steam Turbine	\$5.14/MWh
b. EMC, PSO and EMA license (variable) fees	\$0.55/MWh
c. Consumables (chemicals and town water)	\$0.70/MWh

Fuel Cost

4.19 The fuel cost included in the vesting price is determined quarterly based on the procedures set out in the Vesting Contract Procedures.

5. REVIEW OF WACC PARAMETERS

5.1 The following formula based on the Capital Asset Pricing Model (“CAPM”) is used to determine the post-tax nominal weighted average cost of capital (“WACC”) for determining the opportunity cost of investment for a new entrant:

$$WACC = [g \times (r_f + DP)(1 - t)] + \{(1 - g)[r_f + \beta(r_m - r_f)]\}$$

Where:	r_f	is the risk-free rate
	DP	is the debt premium
	r_m	is the market rate of return
	$(r_m - r_f)$	is the market risk premium (MRP)
	β (equity)	is the measure of the sensitivity of the company’s returns to market returns
	g	is the level of gearing, i.e. debt as a proportion of total assets
	t	is the corporate tax rate

Risk Free Rate, r_f

5.2 The risk free rate is **3.31%**, based on the average daily closing yields of a “AAA” rated 20-year Singapore Government Bond (CTSGD20Y) for March, April and May 2010.

Debt Premium, DP

5.3 The debt premium is **197 basis points** (“bps”). This is based on the benchmark of BBB- credit rating. The resulting debt premium is derived from the difference between (i) the average daily closing yields of Moody’s Utility Bond Index, adjusted upwards by 24bps¹, and Bloomberg’s Fair Value US Utility BBB- Index; and (ii) the average daily closing yields on a 30-year US Treasury Bond with 20 years remaining until maturity for March, April and May 2010.

Gearing, g

5.4 The gearing of **0.342** is derived from the average debt-to-equity ratio of the panel of comparator companies.

¹ It is observed that the difference between the Baa (BBB) and Baa3 (BBB-) US utility bonds is 24 bps (Source: Bloomberg)

Equity Beta, β (equity)

5.5 Given the current lack of long-term contracting in the Singapore power market, the returns for electricity generation would be closely correlated with general economic returns than they might be in other markets (all else being equal). Hence, the equity beta is determined to be **1.00**.

Market Risk Premium, (r_m-r_f)

5.6 The market risk premium (“MRP”) is set at **7%** based on a balanced consideration of several approaches, viz. the forward-looking Dividend Discount Model approach and the Historical Premium approach, Volatility Adjusted approach as well as local and overseas benchmarks (viz. MRPs used by Singapore listed companies and regulators in Australia and UK).

Tax Rate, t

5.7 The tax rate is **17%**, being Singapore’s corporate tax rate.

6. SUMMARY OF LONG RUN MARGINAL COST (LRMC) PARAMETERS FOR SETTING VESTING CONTRACT PRICE FOR THE PERIOD 1 JANUARY 2011 TO 31 DECEMBER 2012

Technical Parameters	Values
Base Month	May 2010
Capacity per Generating Unit (MW)	382
HHV Heat Rate (Btu/kWh)	6,976
Build Duration (months)	30
Economic Lifetime (years)	24
Plant factor (%)	74.9
Capital Cost (S\$ million) <ul style="list-style-type: none"> • Turnkey Engineering, Procurement and Construction (EPC) cost • Discounted through-life capital cost 	586.2
Land, infrastructure and Development Cost (S\$ million) <ul style="list-style-type: none"> • Land and site preparation cost • Connection cost • Miscellaneous cost 	156.6
Fixed Annual Running Cost (S\$ million/year)	22.292
Variable Non-fuel Cost (S\$/MWh)	6.40

WACC Parameters	Values
Risk-free rate, r_f (%)	3.31
Debt Premium, DP (bps)	197
Gearing, g	0.342
Equity Beta, β_{equity}	1.00
Market Risk Premium, $r_m - r_f$ (%)	7.0
Corporate Tax Rate, t (%)	17.0
Post-Tax Nominal WACC (%)	8.28

Vesting Price (S\$ /MWh) 177.80*

*Based on gas price of S\$17.219/GJ used for setting of Q2 2010 tariff.