DRAFT FINAL DETERMINATION
(SUBJECT TO EMA BOARD'S APPROVAL)

LONG RUN MARGINAL COST (LRMC) TECHNICAL PARAMETERS FOR 1 JANUARY 2009 TO 31 DECEMBER 2010

13 AUG 2008

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Review of The LRMC Technical Parameters For Setting Vesting Price For Period 1 Jan 2009 to 31 Dec 2010

Note: This is a Draft Report solely for the purpose of seeking feedback on the assumptions and approach to setting the technical parameters for the Vesting Price for 1 Jan 2009 to 31 Dec 2010.

Introduction

The Energy Market Authority ("EMA") implemented vesting contracts on 1 Jan 2004. The objective of the vesting regime is to control the market power of generation companies ("gencos") in order to promote efficiency and competition in the electricity market for the benefit of consumers. 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 price).

2 The specified price under the vesting contract i.e. vesting 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. At this time the most efficient generation technology is the combined cycle gas turbine ("CCGT").

4 EMA reviews the LRMC parameters every 24 months. In accordance with the established procedures for determining the LRMC parameters, the existing parameters will apply until 31 Dec 2008 and the results of this review will apply from 1 Jan 2009 to 31 Dec 2010.

5 A summary of EMA's draft determination of the LRMC technical parameters to be used to set the vesting price for 1 Jan 2009 to 31 Dec 2010 is set out in Appendix 1. In setting the LRMC technical parameters, EMA took into consideration the recommendations of its consultant, KEMA International BV ("KEMA"). Details of KEMA's derivations of the technical parameters are available in its Draft Final Report dated 12 Aug 2008 "Review of the LRMC costs of CCGT electricity generation in Singapore to establish the technical parameters for setting the Vesting Price for the period 1 January 2009 to 31 December 2010" (hereinafter referred to as "KEMA's report").

6 The Weighted Average Cost of Capital (WACC) used in this paper is 8.72%, which is EMA's draft determination as set out in a separate EMA paper dated 23 Jul 2008 "Review Of The Weighted Average Cost Of Capital (WACC) Parameters For Setting Vesting Price For The Period 1 January 2009 To 31 December 2010" ("WACC determination").

7 As in the draft WACC determination, EMA has adopted Jul 2008 as the Determination month for the setting of the technical parameters for the vesting price for 1 Jan 2009 to 31 Dec 2010. This means that available data up to the last business day of Jun 2008 will be used for determining the technical parameters. The only exception is that EMA has taken in Jurong Town Corporation's (JTC) revised land rental rates that are effective from 1 Jul 2008 for calculating land costs of the

proxy plant, on the consideration that the revised rental rates are more reflective of costs as of the Determination month, compared to JTC's rental rates last published on 1 Jan 2008.

Key LRMC Parameters

Capacity per generating unit (MW)

8 The actual effective plant capacity which would be achievable in Singapore for a 'F' class CCGT (based on ISO rating capacity of 400 MW) is 359 MW, after taking into account typical energy losses, local air temperature, local air pressure, local cooling water temperature, ageing of plant and compressor fouling.

HHV Heat Rate

9 A simple average of the heat rates of the modeling results in KEMA's report over 20 years is used. The heat rate for the proxy plant using modeling in KEMA's report (with refurbishment) is 6980 Btu/kWh. This heat rate value takes into account the average plant heat rate on site, the impact of ageing, part load, the number of starts, life time extension and reserve allocation.

Build Duration

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

Economic Lifetime

11 The economic lifetime of the proxy plant is set at 20 years.

Plant Factor

12 EMA has continued to adopt the approach of setting the plant factor based on the actual performance of the most efficient CCGTs in operation in the system. This is then projected forward for the two years of the review period and if necessary adjusted downwards to take account of any expected constraints on the operation of this capacity.

13 The criteria for the inclusion of CCGT plants is that the CCGT must be a 'F' class technology machine. The average plant factor of the CCGTs considered by EMA (Senoko CCP 3 to 5, Seraya CCP1 and CCP2, Tuas CCP 1 to 4) over the last 12 months (Jul 2007 to Jun 2008) is 75%. This number is then checked to ensure that this plant load factor is achievable for 2009 and 2010 i.e. the total output of all CCGT plants must be less than the total demand, taking into account projected increase in load. The plant factor is therefore set at 75%.

Capital Cost

14 In its assessment of this cost, EMA has assumed that the new genco will develop 2 units of 400 MW CCGT so as to achieve economies of scale through sharing the costs of common items such as land, site development and basic infrastructure to support operation of the CCGT. These shared costs are allocated evenly to each of the 2 units.

15 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. The capital cost excludes the costs of installation, switchgears, fuel tanks, transmission and fuel connections, land, buildings and site development. These costs are included as part of the "land, infrastructure and development costs".

16 The total capital cost of the power plant (2 units of 400MW CCGTs) is $605.4 million. This yields a capital cost of $302.7 million per 400 MW unit, which comprises of the single gaseous fuel plant at $286.1 million, dual fuel hot switching capability at $10.65 million and transport costs of $5.95 million.

Land, Infrastructure & Development Cost (including Re-investment Cost)

17 The total land, infrastructure and development costs, including re-investment cost amounts to $207.55 million for each 400 MW unit. The detailed cost breakdown (for one 400 MW CCGT unit) is given below:

a. Land Cost: $13.6 million

The land cost comprises land lease cost, water front fees and land preparation costs.

b. Facilities cost: $30.65 million

This includes the cost of ancillary buildings, demineralization plant, seawater intake/outfall structures, constructing the jetty for emergency fuel unloading facility, and gas receiving facilities.

c. Emergency fuel facilities: $22.7 million

This is estimated based on fuel storage required to store backup fuel for the CCGT.

d. Connection charge: $34.1 million

This includes the standard connection charge of $50,000 per MW and the cost of 230kV switchgear.

e. Installation cost: $79.55 million

This includes the civil works for the plans, erection and assembly, detailed engineering and start-up costs, as well as contractor soft costs.

f. Consultancy cost: $10 million

This includes consultant's fees for basic engineering studies, legal and financial advice.

g. Miscellaneous owners & start-up cost: $10.5 million

This includes owners' manpower cost up to and including contract award, owners' manpower cost during construction, taxes and

insurance during construction, and purchased electricity, water and fuel during construction.

h. Reinvestment Cost (upon subtraction of residual cost): $6.45 million
A re-investment cost to extend the lifetime of the plant after 12 operating years has been estimated at present value of $26.8 million for one 400 MW CCGT unit. The lifetime extension after the re-investment is 12 years (giving 24 year lifetime in total). The residual value of 4 years of remaining lifetime is estimated to be at present value of $20.35 million, resulting in a reinvestment cost of $6.45 million.

Variable Non-Fuel Cost

18 The variable non-fuel cost was estimated at $1.03/MWh. This comprises $0.3661/MWh for EMC charges, $0.2104/MWh for PSO charges, and the remaining $0.4509/MWh for consumables (specifically water and chemicals).

Fixed Annual Running Cost

19 The fixed annual running cost includes the maintenance, operating and overhead costs that are incurred annually to keep the plant in a ready state for supplying energy and reserves. The variable non-fuel cost includes the costs, other than fuel costs, that vary with the level of energy output.

20 The fixed annual running cost of $48.3 million per annum (for one 400 MW CCGT unit) comprises $9.2 million for manpower and overhead costs, $15.5 million for the carrying cost for backup fuel and $23.6 million for maintenance.

~ End ~

Appendix 1

DRAFT LRMC TECHNICAL PARAMETER VALUES TO SET VESTING PRICE FOR 1 JAN 2009 TO 31 DEC 2010

S/No.	Parameter	Draft Value for 2009 to 2010	Value for 2007 to 2008
1	Base Year	2008	2006
2	Capacity per generating unit (MW)	359	364
3	HHV Heat Rate (Btu/kWh)	6980	6929
4	Build Duration (months)	30	27
5	Economic Lifetime (years)	20	20
6	Plant Factor	75%	75%
7	Capital Cost (S$million)	302.70	287.02
8	Land, Infrastructure & Development Cost, including re-investment cost (S$million):	207.55	162.03
9	Total Capital and Land, Infrastructure & Development Cost (S$million)	510.25	449.05
10	Variable Non-Fuel Cost (S$/MWh)	1.03	0.99
11	Fixed Annual Running Cost (S$million /year)	48.3	38.0
12	Vesting Price ($ / MWh)	194.08[1]	183.25

[1] Based on gas price of $17.721 /GJ (used for calculation of vesting price in quarter 3 of 2008 and draft WACC determination of 8.72%.