FINAL DETERMINATION

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

22 DECEMBER 2008

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1. INTRODUCTION

The Energy Market Authority ("EMA") implemented vesting contracts on 1 Jan 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 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).

The 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.

This report summarizes EMA's determination of the LRMC parameters used to set the vesting price for the period 1 January 2009 to 31 December 2010, in accordance with the established procedures set out in the document "EMA's Procedures for Calculating the Components of the Vesting Contracts" available at (http://www.ema.gov.sg/doc/procedures.pdf)

In this determination, EMA took into consideration the recommendations of its consultant, KEMA International BV ("KEMA") and the feedback received during consultation with the public and industry. A copy of KEMA's final report is available at http://www.ema.gov.sg/doc/10010665_CCGT_RMC_Calcs_Final.pdf

2. TECHNICAL PARAMETERS

2.1 Generating Technology

2.1.1 Introduction

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 price, EMA considers a new entrant will have a plant size of 2 units of 400MW CCGTs. The costs of common items such as land, site development and basic infrastructure to support the operation of the CCGT would be shared between the 2 plants.

2.1.2 Capacity per generating unit

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

2.1.3 Heat Rate

The heat rate of 7085 Btu/kWh is used for the proxy plant. This is the simple average of the heat rates of the modeling results in KEMA's report over 20 years (with refurbishment). It takes into account the average plant heat rate on site, the impact of ageing, part load, number of starts, lifetime extension and reserve allocation, as well as adjustment for house loads.

2.1.4 Build Duration

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

2.1.5 Economic Lifetime

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

2.1.6 Plant Factor

The plant factor is set at 74%, based on the actual performance of the "F" class CCGTs in operation in the system, (Senoko CCP 3 to 5, Seraya CCP1 and CCP2, Tuas CCP 1 to 4 from Nov 2007 to Oct 2008) and checked to be achievable for 2009 and 2010.

2.2 Investment Costs

2.2.1 Capital cost

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 total capital cost for 1 unit of 400MW CCGTs is $325.1 million, comprising of:

- Single gaseous fuel plant $308.9 million
- Dual fuel hot switching capability $9.85 million
- Transport cost $6.35 million

The capital cost excludes the cost of installation, switchgears, fuel tanks, transmission and fuel connections, land, buildings and site development.

2.2.2 Land and site preparation cost

The total land and site preparation cost for each 400 MW unit is $67.6 million, comprising of:

- Land lease cost, water front fees and land preparation $13.3 million
- Ancillary buildings, demineralization plant, seawater intake/outfall structures, constructing the jetty for emergency fuel unloading facility, and gas receiving facilities $31.15 million
- Emergency fuel facilities $23.1 million

2.2.3 Connection and installation cost

The total connection and installation cost for each 400 MW unit is $113.9 million, comprising of:

- Connection charge of standard connection charge ($50,000 per MW) and cost of 230kV switchgear $34.1 million
- Civil works for the plans, erection and assembly, detailed engineering and start-up costs, as well as contractor soft costs $79.8 million

2.2.4 Miscellaneous costs

- Consultant's fees for basic engineering studies, legal and financial advice $10 million

- 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 $9.1 million

- Reinvestment Cost after 12 operating years to extend the lifetime of the plant $7.4 million

2.3 Non-fuel Operation Costs

2.3.1 Fixed Annual Running Cost

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 fixed annual running cost for one unit of 400MW CCGT is $41.0 million per annum comprising of:

- Manpower and overheads $8.95 million
- Carrying cost for backup fuel $10.3 million
- Maintenance $21.75 million

2.3.2 Variable Non-Fuel Cost

The variable non-fuel cost, estimated at $1.05/MWh, includes the costs, other than fuel costs, that vary with the level of energy output. This comprises $0.3661/MWh for EMC charges, $0.2104/MWh for PSO charges, $0.0224/MWh for the average annual license fees paid by the new entrant and the remaining $0.4523/MWh for consumables (specifically water and chemicals).

2.4 Fuel Costs

The fuel cost included in the vesting price is determined quarterly based on the procedures set out in the vesting contract document available at (http://www.ema.gov.sg/doc/vestingcontract.pdf)

3. WACC PARAMETERS

3.1 Introduction

The following formula based on CAPM is used to determine the weighted average cost of capital ("WACC") for the opportunity cost of investment for a new entrant. EMA has adopted Nov 2008 as the "Determination Month" for the WACC determination. Available data up to the last business day of Oct 2008 is used for the calculation of data inputs to derive of the WACC parameters.

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

Where:

r_f	is the risk-free rate of return
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 capital
t	is the corporate tax rate

3.2 Risk Free Rate

The risk free rate is 3.55%, being the average of the daily closing yields in Oct 2008 for the 20-year Singapore Government Bond, NZ07100S.

3.3 Debt Premium

The debt premium is 550 basis points. This is based on the credit spread of BB+ rated 10-year corporate bonds issued by utilities companies as published by the Bondsonline Group[1] on 31 Oct 2008.

3.4 Equity Beta & Gearing

The equity beta is 1.08 and the gearing is 0.50. These are derived based on publicly listed comparator companies[2] that match the operating risk profile of the new entrant CCGT, with publicly available data and not in financial distress for the last 5 years.

3.5 Market Risk Premium

The market risk premium ("MRP") is set at 7%. This is a balanced consideration of several approaches, viz. the forward-looking Dividend Growth Model approach and

[1] Reuters market data

[2] International Power PLC was selected as the comparator company. Information on the determination of the comparator companies is available at http://www.ema.gov.sg/attachments/Consultation/20080723104454_5791_Draft_Determination_of_WACC_parameters_for_1_January_2009_to_31_december_2010.pdf

the Historical Premium approach, as well as local and overseas benchmarks (viz., MRPs used by Singapore listed companies and those used by regulators in Australia and UK).

3.6 Tax Rate

The tax rate is 18%, being Singapore's corporate tax rate.

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

Parameter	Value
Technical Parameters	
Base Year	2008
Capacity per generating unit (MW)	359
HHV Heat Rate (Btu/kWh)	7085
Build Duration (months)	30
Plant Factor	74%
Capital Cost (S$million)	325.1
Land and Site Preparation Cost (S$million)	67.6
Connection and Installation Cost (S$million)	113.9
Miscellaneous Cost (S$million)	26.4
Financing cost in construction period (S$million)	66.0
Fixed Annual Running Cost (S$million /year)	41.0
Variable Non-Fuel Cost (S$/MWh)	1.05
WACC Parameters	
Risk Free Rate, rf	3.55%
Debt Premium, DP	550 bps
Market Risk Premium, MRP	7%
Gearing, g	0.50
Equity Beta, β_{equity}	1.08
Corporate Tax Rate, t	18%
Nominal Post Tax WACC	9.25%
Vesting Price ($/MWh)	167.14[3]

**Numbers are rounded off for presentation*

[3] Based on gas price of $15.575/GJ