Appendix AF

Quantification of Mercury Emissions

Mercury emissions were quantified in three ways to determine the maximum likely emissions, viz.:

(a) Based on the total mercury content of the coal being combusted (Table 1);
(b) Based on emission factors from the European Environment Agency (EEA) Emissions Inventory Guidelebook – Combustion in Energy & Transformation Industries (15 February 1996) (Tables 2 and 3);
(c) Based on emission factors included in the European Commission Integrated Pollution Prevention & Control (IPPC) Draft Document on Best Available Technology for Large Combustion Plants (November 2004) (Tables 4 and 5).

The relevant coal data and emissions factors are documented and the estimated emissions based on such presented in Tables 1 to 5 for the existing Matimba Power Station and proposed power station options (2400 MW and 4800 MW). In the application of the EEA emissions factors reference was made to the more conservative of the two factors given (i.e. power station has dust control but no FGD in place). Similarly, in the application of the IPPC emissions factors the emissions factors given for power stations using an ESP but no scrubber desulphisation were applied. A synopsis of the maximum mercury emissions rates estimated on the basis of the coal composition, EEA ad IPPC emission factors is given in Table 6.

Table 1. Predicted maximum possible mercury emissions based on the quantity of coal combusted / to be combusted and the mercury content of the coal as measured at the existing Matimba Power Station

Power Station	**Coal (tpa)**	**Hg Content of Coal (%)**	**Maximum Possible Hg Emissions (tpa)**
Current Matimba (max, 2004)	14,041,024	4.50E-05	6.32
Proposed (4800 MW)	17,117,436	4.50E-05	7.70
Proposed (2400 MW)	8,558,718	4.50E-05	3.85

Table 2. Mercury emission factors for coal-fired power stations from the European Environment Agency (EEA) Emissions Inventory Guidelebook – Combustion in Energy & Transformation Industries (15 February 1996)

Emission Control Measures In Place	**Mercury Emission Factor for Coal-Fired Power Stations**	
	Minimum (g/Mg coal)	**Maximum (g/Mg coal)**
Dust control (particulate loading in clean gas stream of 50 mg/Nm^3)	0.05	0.20
Dust control & FGD (particulate loading in clean gas stream of 20 mg/Nm^3)	0.02	0.08

FGD – fluidized gas desulphurisation

Table 3. Estimated mercury emissions based on the emission factors given in European Environment Agency (EEA) Emissions Inventory Guidelebook – Combustion in Energy & Transformation Industries (15 February 1996) as published for coal-fired power stations with dust control in place only (no FGD)

Power Station	Estimated Mercury Emissions	
	Minimum Hg Emissions based on Minimum Mercury Emission Factor given for Dust Controlled Power Stations (tpa)	Maximum Hg Emissions – based on the Maximum Mercury Emissions Factor Given for Dust Controlled Coal-Fired Power Stations (tpa)
Current Matimaba (max, 2004)	0.70	2.81
Proposed (4800 MW)	0.86	3.42
Proposed (2400 MW)	0.43	1.71

Table 4. Mercury emission factors for coal-fired power stations from the European Commission Integrated Pollution Prevention & Control (IPPC) Draft Document on Best Available Technology for Large Combustion Plants (November 2004).

Emission Control Measures In Place	Mercury Emission Factor for Coal-fired Power Stations		
	Minimum Hg Emissions ($\mu g/m^3$)	Average Hg Emissions ($\mu g/m^3$)	Maximum Hg Emissions ($\mu g/m^3$)
Hg concentration in gas stream downstream of ESP	0.3	4.9	35
Hg concentration downstream of ESP and wet scrubber desulphurisation	0		5

Table 5. Estimated mercury emissions based on IPPC emission factors given for mercury concentrations downstream of an ESP (no wet scrubber desulphurization)

Power Station	Minimum Hg Emissions (tpa)	Average Hg Emissions (tpa)	Maximum Hg Emissions (tpa)
Current Matimba (max, 2004)	0.06	0.99	7.08
Proposed (4800 MW)	0.06	1.04	7.41
Proposed (2400 MW)	0.03	0.52	3.70

A synopsis of the maximum mercury emission rates estimated on the basis of the coal composition, EEA and IPPC emission factors is given in Table 6. The emissions estimated on the IPPC emission factors and on the basis of site-specific coal qualities are relatively similar, whereas the application of the EEA emission factors result in lower mercury emission estimates.

Table 6. Comparison of estimated mercury emissions based on mercury content of Matimba coal, IPPC emission factors and EEA emission factors

Power Station	**Maximum Hg Emissions based On Coal Quality (tpa)**	**Maximum Hg Emissions based on IPPC Emission Factors (tpa)**	**Maximum Hg Emissions based on Emission Factors (tpa)**
Current Matimba (max, 2004)	6.32	7.08	2.81
Proposed (4800 MW)	7.70	7.41	3.42
Proposed (2400 MW)	3.85	3.70	1.71

Predicted Ambient Mercury Concentrations and Health Risk Potentials

In the simulation of ambient mercury concentrations and resultant air quality impacts reference was made to the maximum emission rates (i.e. 7.08 tpa for current Matimba operations, 7.70 tpa for the proposed 4800 MW power station configuration and 3.85 for the proposed 2400 MW power station configuration). Ground level mercury concentrations were predicted using the same atmospheric dispersion modelling approach as was documented in the air quality impact study. The maximum highest hourly, highest daily and annual average ground level mercury concentrations occurring as a result of existing Matimba Power Station emissions together with the proposed 4800 MW PF power station are given in Table 7.

Table 7. Predicted mercury concentrations given existing Matimba Power Station emissions together with emissions from the proposed 4800 MW PF power station with reference to applicable guidelines intended to protect human health.

	PREDICTED MERCURY CONCENTRATIONS GIVEN EXISTING AND PROPOSED 4800 MW POWER STATION OPERATIONS			
	Highest Hourly (μg/m^3)	Highest Hourly (μg/m^3)	Highest Monthly (μg/m^3)	Annual Average (μg/m^3)
Predicted Maximum Total Hg GLCs (μg/m^3)	0.127	0.011	0.003	0.001
RELEVENT GUIDELINES (μg/m^3)				
WHO Guidelines Value				1.00
US-EPA inhalation Reference concentration				0.30
Texas Effect Screening Levels	0.25			0.025
California RELs	1.8			0.09
DEAT Mercury Guideline (a)				0.04

REL – reference exposure level; GLCs – ground level concentrations; DEAT – Department of Environmental Affairs and Tourism

(a) Published in DEAT document "Technical Background Document for Mercury Waste Disposal" (2001).

The predicted maximum hourly, daily and annual average concentrations were well-within the most stringent of the guidelines given for public exposures to ambient mercury concentrations intended for the inhalation pathway (e.g. WHO, US-EPA inhalation reference concentrations, Californian RELs).

It is noted that the major pathway for mercury exposures is ingestion rather than inhalation. For this reason reference was made to the DEAT mercury guidelines which was intended to be protective given multiple pathways of exposure. This guideline value (given as 0.04 μg/m^3 for chronic exposures) was derived during a recent study initiated by the Department of Environmental Affairs and Tourism. This study included health-risk based research relating to human exposure to mercury and engineering reviews of treatment and disposal options for mercury waste. The purpose of such studies was twofold: (i) to support the drafting of national regulations for mercury waste disposal; and (ii) to provide specific guidance on how best to deal with the mercury waste stockpiled at the Thor Chemical's plant at Cato Ridge, Kwazulu-Natal. The health risk study determined that ambient long-term concentrations of mercury of lower that 0.04 μg/m^3 would not result in unacceptable multi-pathway risk given local environments. This guidance is currently being used by the DEAT to assess the acceptability of mercury waste treatment and disposal options.

Conclusions

The potential for health risks associated with long-term public exposures to mercury emissions from coincident operations of the existing Matimba and proposed 4800 MW Power Station are predicted to be low even given the potential for multi-pathway exposures. The implementation of very costly mitigation measures exclusively for the reduction of mercury emissions appears unjustified given this finding. It is however noted that the implementation of certain control measures intended to reduce particulate, sulphur dioxide and nitrogen oxide emissions may control mercury emissions to some extent, thus offering additional motivation for the implementation of such measures (inline with the precautionary principle).

With regard to the implementation of control measures to reduce mercury emissions the following observations are made, based on the IPPC BREV document (November 2004):

- Fabric filters have a control efficiency of 40% for mercury
- Spray drying scrubbers have a 35% to 85% control efficiency for mercury
- Sodium scrubbing using NaVCIO as the additive can result in a 95% control efficiency for mercury
- For ESPs and fabric filters, operated in combination with FGD techniques, for example limestone scrubbers, spray dry scrubbers or dry sorbent injection, the average mercury removal rate 75% (50% in ESP and 50% in FGD) and 90% with the additional use of a high dust SRC.