Eskom

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Dear Ms McCourt

MERCURY REMOVAL AT KUSILE POWER STATION

The requirement for mercury emission reduction in the Record of Decision (RoD) for Kusile Power Station (17 March 2008) has reference. Condition 3.7.6 in the RoD states that *'Eskom must indicate the technology to be installed to reduce the emission of mercury into the atmosphere. The percentage and minimum of by how much this reduction will take place must be provided in the construction EMP.'*

Atmospheric mercury emissions from Kusile Power Station will be reduced by the fabric filter plant and wet flue gas desulphurisation plant (FGD) to be installed on all units of Kusile Power Station. The magnitude of the mercury emission reduction cannot be determined at this stage; however, as it is dependent on the coal used and the conditions of combustion, and will need to be measured once the power station is operational. It is requested that condition 3.7.6 of Kusile's RoD be deferred until a year after the power station has been commissioned, at which time the mercury emission reduction will be measured, and the Operations Environmental Management Plan (EMP) amended to include the percentage emission reduction.

Background: mercury from coal combustion

Mercury compounds from combustion sources mainly consist of gaseous elemental mercury (Hg_0), particle-bound mercury (Hg_p), and oxidized mercury (Hg^{2+}). Mercury exists in coal used by Eskom in low levels (below 1 μg/g). In the combustion zone in the boiler, most of the mercury in the coal is evaporated and exists as the elemental form of mercury (Hg_0), but as the flue gas is cooled downstream of the boiler, the mercury can be oxidized by flue gas components such as sulphur dioxide (SO_2), moisture (H_2O) or hydrochloric acid (HCl) if there is sufficient chlorine in the coal, or condense onto fly ash particles, forming an oxidized form of mercury (Hg^{2+}) such as HgO or $HgCl_2$ (Sloss, 2008: Economics of Mercury Control, International Energy Agency Clean Coal Centre).

Mercury removal by fabric filter plants

Internationally, units with fabric filters show a large variability in mercury removal ranging from low to over 90% depending on the coal and combustion conditions. For bituminous coal from the

eastern United States, for example, an average of 89% (range of 84-93%) of mercury was found to be removed by the fabric filter plant, for flue gas which has 30-40% elemental mercury and 60-70% oxidized mercury (2 units tested) (EPRI Mercury Control Selection Guide, September 2006).

Fabric filter plants are effective at capturing mercury because the filter cake on the bags acts as a fixed-bed reactor for unburnt carbon to enhance mercury capture (Sloss, 2008). Fabric filter plants are the only particulate control devices to remove an appreciable amount of elemental mercury, but according to data from the US EPA mercury Information Collection Request (ICR), this occurs only at coal chlorine contents above 200 ppm. Chlorine content in the coal from four borehole samples from the New Largo coal mine, which will supply Kusile, ranged between 140 and 220 ppm, and averaged 180 ppm. It follows that the formation of oxidized mercury may be limited by the reaction rate of chlorine with elemental mercury in the flue gas. However, the presence of unburnt carbon in ash enhances mercury capture by adsorbing oxidised mercury. There will be a higher amount of unburnt carbon in ash at Kusile since low NO_x burners are being installed.

Mercury removal by wet FGD

Studies in the USA, Canada, Japan, Germany, Austria and Denmark all show that wet FGD systems remove at least 50% of the mercury. Units tested for the EPA's mercury ICR showed that mercury removal averages 75% (range of 62-89%) for units with wet FGD and fabric filter plants and 69% (range of 64-74%) for units with wet FGD and electrostatic precipitators (2 units tested in each case). According to the US Department of Energy (2001), wet FGD can typically remove 75-90% of the oxidized mercury in the flue gases, and 55% of total mercury.

Most wet scrubbers used for SO_2 control achieve high removals of oxidized mercury and little or no elemental mercury removal. The capture of mercury in FGD systems is thus dependent on the oxidation state of the mercury and anything which enhances mercury oxidation will enhance mercury capture in the FGD. The majority of mercury from US bituminous coals is in the oxidised form and therefore can be removed in an FGD system. Elevated chlorine concentrations often correlate with higher concentrations of oxidised mercury. There have been problems reported with mercury re-emission from wet scrubbers, however.

Conclusion

There is a high level of uncertainty as to how much mercury will be removed at Kusile because:

- mercury removal achieved by fabric filter plants and wet FGD internationally has been measured on very few units
- the speciation of the mercury in the flue gas at Kusile is unknown, and it depends on the chlorine content of the coal, the amount of unburnt carbon in ash, the time taken for the flue gas to pass through the fabric filter plant, and a number of other factors.
- it is not known whether there will be mercury re-emissions from the wet FGD scrubber.

While international studies show that mercury emissions from Kusile will be reduced by the fabric filter plant and wet FGD, it is requested that condition 3.7.6 in the Kusile RoD for the amount of mercury removed from Kusile's flue gas to be stipulated in the construction EMP be deferred. Instead, it is proposed that mercury emissions from Kusile be measured within a year of the last unit at Kusile being commissioned. The Operations EMP will then be amended to stipulate the minimum mercury emission reduction to be achieved at Kusile.

You are welcome to contact us if you require any further information in this regard.

Yours sincerely

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