Eskom
Generation

Mr C Brand
Working Group 1: Minimum Emission Standards:
Combustion Installations, Petroleum Industry, and
Carbonisation and Coal Gasification
SABS SC 146 A: Quality Standard: Source Emissions

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Dear Sir

ESKOM SUBMISSION ON PROPOSED MINIMUM EMISSION LIMITS FOR COMBUSTION INSTALLATIONS

Table 2, item 2.2.1 Combustion Installations in the proposed *Regulations Relating to Listed Activities and Minimum Emission Standards* refers.

1. **Recommendation**: provision be made for reviewing emission standards on a regular basis as our experience and operational knowledge grows. A five year review period should be sufficient.

2. It is proposed that the limits be practical to implement so that there is not a continual risk of non-compliance. Furthermore, the standards should take account of resource, technological and cost constraints, since these constraints affect the ability to meet standards.

3. We note, with concern, that there is no reference to population agglomerations, location of plant, population size or existing state of the airshed in the proposed emission standards document, even though the stated purpose of emission limitations is to protect human health.

   Recommendation: emission standards to be set taking into account the generally remote location of power plants in South Africa. If power plants are to be situated in close proximity to populated areas, more stringent standards could be negotiated with the local authority.

4. We note, with concern, that proposed emissions limits, expressed as concentrations, are not qualified in terms of averaging periods.

   Recommendation: the approach used by the EU is adopted. This states:

   - there is compliance if none of the calendar monthly mean values exceeds the emission limits values,

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- for sulphur dioxide (SO_2) and particulate matter (PM), 97% of all 48 hourly mean values must not exceed 110% of the emission limit values,
- for oxides of nitrogen (NOx), 95% of all 48 hourly mean values must not exceed 110% of the emission limit values.

These limits only apply to normal operation and do not apply during start-up, shut-down or upset conditions.

5. For SO_2, Eskom proposed a concentration limit for existing plant of 4000mg/Nm^3 based on measured values.

Recommendation: an SO_2 concentration limit of 4000mg/Nm^3 for existing plant, as a monthly mean concentration, be adopted. As per EU practice, this limit is only to be applicable to normal operation and will not apply during start-up, shut-down or upset conditions.

Justification: Sulphur emissions are determined by the sulphur content of the coal. Eskom's coal-fired power stations use low sulphur coal, with sulphur content averaging 0.87%.

There is a possibility of removing sulphur either post-combustion with flue gas desulphurisation (FGD), or pre-combustion by coal washing or de-stoning to remove some of the sulphur from the coal. FGD can only be implemented if sufficient water, sorbent and funding are available, and if there is sufficient space at an existing station for an FGD retrofit. To operate FGD on a 6 by 600 MW power station would require between 400 000 and 500 000 tons of sorbent (limestone) per annum (depending on the power station and the coal used) and around 7 Mm^3 of water per annum. (To put this in perspective, a 6 by 600 MW dry-cooled power station requires between 3 and 3.5 Mm^3 of water per annum). Total sorbent reserves in South Africa have not been well ascertained, but sorbent is in great demand for new coal-fired power stations. Water for FGD retrofits will only be available from 2018 or later once an inter-basin transfer scheme from either the Lesotho Highlands or the Tugela system is constructed. A 2007 report compiled by EON Engineering estimates the capital costs (excluding the costs of financing) of installing wet FGD on a 6 by 600 MW power station to be just over R3 billion, and the annual operating costs for a wet FGD with 90% removal efficiency to be between R205 million and R230 million. Recent indications are that these costs are likely to be considerably higher. The decision to retrofit FGD on an existing power station should also take into account the remaining life of the power station (some stations are scheduled to be decommissioned from 2025 onwards), the outage requirement (a half-station shut down is required for at least 3 months to line the stacks – this is not possible until 2014 at the earliest due to the low reserve margin), and the impact of sulphur emissions from the power station on people residing in the vicinity.

Coal used at some power stations (like Matimba) is already washed; investigations have been initiated to see whether it is feasible to implement coal beneficiation at other stations. However, coal washing and destoning can only remove mineral and not organic sulphur, and the potential for sulphur removal differs considerably from mine to mine. The feasibility of coal beneficiation needs to be established, and environmental costs weighed before a decision can be made in this regard.

Some leniency in the standard is required in order to account for variations in the sulphur content of the coal used at the stations. Tutuka power station sources coal from 14 different mines, for example. More stringent standards can be negotiated with the Department of Environmental Affairs and Tourism for the emission licences for power stations with lower sulphur coal.

6. The emission concentration limit for SO_2 of 400mg/Nm^3 for new plant will eventually be achievable in the medium term, providing that it is defined as a monthly mean concentration.

Recommendation: an initial limit of 500mg/Nm^3 be adopted as we have no experience thus far to guide us on how well the chosen SO_2 mitigation technologies will work with local resources and under local conditions.

Justification: Achieving an SO_2 limit of 400 or 500 mg/Nm^3 requires the installation of FGD with high (~90%) removal efficiency. However, large combustion installations in South Africa have not operated FGD previously, and there may well be a learning curve until the FGD plant can be operated optimally.

7. The NOx figures originally supplied to DEAT were quoted as equivalent nitric oxide (NO) concentrations, not equivalent nitrogen dioxide (NO_2) concentrations as defined in the proposed standards document. The bulk of Eskom's NOx emissions are indeed in the form of NO and this was how NOx concentrations were historically reported for internal purposes.

   A NOx emission concentration standard of 800mg/Nm^3 expressed as equivalent NO_2, for existing plant is too low and inconsistent with actual measured emissions from existing plant. A monthly average concentration limit of 1700mg/Nm_3 NOx, expressed as equivalent NO_2, is realistic for Eskom's existing fleet.

   Recommendation: a monthly average concentration limit of 1700mg/Nm^3 NOx, expressed as equivalent NO_2. be adopted.

   Justification: Most NO_x from combustion installations is thermal NO_x, formed during the combustion process from nitrogen in the air. NOx emissions could be reduced by replacing the burners with low NOx burners (with over-fire air) or installing selective non-catalytic reduction (SNCR) (both of which achieve emission reductions of 30-40%) or installing selective non-catalytic reduction (SNCR) (achieves emission reduction of around 70%). Installation of low NOx burners is easier for an operational perspective, because it does not involve running an additional plant. Steinmüller estimates that the cost of a low NOx burner, excluding installation, is R3 million, and 30 burners would be required for a 600 MW unit. It would cost roughly R540 million plus installation costs to retrofit a 6 by 600 MW power station with low NOx burners. SNCR is expected to be slightly cheaper but more difficult to operate than low NOx burners, and SCR is considerably more expensive. The retrofit of low NOx burners could be performed in 6-8 weeks during a General Overhaul (GO); installing the tubing for over-fire air would push the installation time up to 12 weeks. Ambient NO_2 levels in the vicinity of combustion installations are well below ambient air quality limits, so there is little justification to reduce current NOx emissions.

8. The proposed NO_x limit of 500mg/Nm^3 for new plant is too low and inconsistent with expected emissions.

   Recommendation: a realistic concentration limit of 750mg/Nm^3 be adopted for NOx, expressed as equivalent NO_2, applicable to a monthly mean value, noting that the 1998 World Bank limit is 750mg/Nm^3.

   Justification: A NOx emission limit of 750 mg/Nm^3 is already a considerable improvement over the limit of 1700 mg/Nm^3 for existing plant, and is achieved with low NO_x burners and overfire air. Monitored data shows that ambient NO_x levels in the vicinity of power plants are well below ambient air quality limits, and the impact of NOx emissions from power stations on human health is negligible.

9. High ambient carbon monoxide (CO) concentrations are normally attributable to motor vehicle emissions, not stationary combustion sources, particularly those equipped with tall stacks to ensure good plume dispersion. Further, ultra lean combustion conditions, needed for significant CO production are not generally conducive to safe and smooth boiler operations. Indeed, neither the World Bank nor the EU prescribes emission concentration limits for CO from stationary combustion sources.

   Recommendation: the reference to CO emissions from stationary combustion sources be deleted.

   Justification: Combustion installations are not significant sources of CO. Spot measurements conducted at Eskom's coal-fired power stations in 2005 show that CO concentrations in the flue gas stream range between 2 and 14 mg/Nm^3 at 6% O_2 during normal operation at full load.

10. A PM limit of 75mg/Nm^3 for existing plant cannot be implemented immediately at all power stations but can ultimately be achieved on a station-by-station basis, as stipulated in the current emission licences.

Recommendation: reach mutual agreement on a realistic improvement plan, prioritising the work programme on the basis of both plant availability and degree of improvement needed.

Justification: Reduction of PM emissions involves upgrading the electrostatic precipitator, installation of a flue gas conditioning plant and/or retrofit of a fabric filter plant. These upgrades need to be planned for in the technical plans, and an appropriate outage needs to be scheduled.

11. In our view a PM limit of 20mg/Nm^3 for new plant in a developing country like South Africa is not justified. This is more stringent than the 30 mg/Nm^3 required in the EU. Emissions from stacks are not visible when the particulate concentrations are below 50mg/Nm^3. Further, extensive monitoring shows that ambient concentrations of PM attributable to power stations with tall stacks are virtually negligible at ground level. Thus there are unlikely to be any significant health benefits to be derived from lowering the permissible particulate concentration below the limit of visibility.

Recommendation: a particulate emission concentration limit of 50 mg/Nm^3 be adopted for new plant.

Justification: Coal used at Eskom's power station typically has low calorific value and high ash content (average calorific value of 18.5 MJ/kg and average ash content of 29.1%, with some stations burning coal with CV as low as 15 MJ/kg and ash content as high as 41%). Since coal used for power generation in South Africa is generally of much lower quality than that used in the European Union, and it cannot be assumed that the EU emission limits will be as easy to implement in South Africa. The lower calorific value and higher ash content translate to a higher burn rate (more coal needs to be burnt to generate the equivalent amount of electricity). As a result, there is a significantly higher burden on the electrostatic precipitators and bag filters. The particulate abatement plants in South Africa need to be physically bigger than those used in Europe. Furthermore, South African coal has a low sulphur content which means that the ash has a higher resistivity, and is more difficult for an electrostatic precipitator to collect. In order to achieve a particulate emission rate of 50 mg/Nm^3, the abatement technology needs to operate at a removal efficiency of more than 99.99%.

The particulate abatement technology (fabric filter plants) for the two new power stations under construction, Kusile and Medupi, is guaranteed for a particulate emission limit of 50 mg/Nm^3. The fabric filter plant will cost R720 million for each station; an electrostatic precipitator achieving the same emission rate was quoted at R1.4 billion for each station. In order to lower the emission rate from 50 to 30 mg/Nm^3, the fabric filter plant would need to be increased by 25% (additional cost of R180 million per station), and the electrostatic precipitator would need to be increased by 45% (additional cost of R620 million per station).

Some leniency in the particulate emissions standard is required in order to account for variations in operating conditions and coal quality or sulphur content (precipitator performance and bag condition are affected by changing sulphur content, ash content and CV of the coal).

12. It is noted, with concern, that the proposed emission concentration limits for gas turbines are referenced to 6% oxygen (O_2). The international norm is 6% O_2 for solid fuel installations but 15% O_2 for gas turbines. Gas turbine plant is bought 'off the shelf' and is designed to run at 15% O_2.

Recommendation: 15% O_2 be referenced for emission concentration limits for gas turbine installations.

13. It is not international practice, neither World Bank nor the EU, to prescribe emissions limits for CO from gas turbines.

    Recommendation: the reference to CO emissions for gas turbines be deleted.

    Justification: Gas turbines are not a significant source of CO. CO emissions at the Gourikwa and Ankerlig Open Cycle Gas Turbines average less than 1 mg/Nm^3 during normal operation.

14. The proposed emission concentration limits for PM, SO_2 and NOx for gas turbines may be acceptable provided that they are defined as hourly mean values and are only applicable to normal operation. They will not apply during start-up, shut-down or upset conditions.

    Recommendation: further work be done to establish reasonable limits for the different fuels that will be combusted in the turbines. Different emission limits should be set for gas and liquid fuels.

15. On-line gaseous stack monitoring of SO_2, NOx and O_2 will originally be implemented on one unit only at each power station by the end of 2011. It is expected that all units will be equipped with monitors by the end of 2013. It is impractical to accelerate the program as time will be required to test the monitors and ensure that they are giving in-specification data. The process is also complicated by the fact that the installation of on-line stack monitors will require significant unit outage time. The ability to do this will depend on system capacity which is unlikely to be favourable for some time into the future.

    Recommendation: DEAT give sufficient time for Eskom to complete a successful programme of installing on-line gaseous emission monitors, corresponding to planned outage cycles.

    Recommendation: where on-line stack monitoring is mandated, data capture should be a minimum of 90% of the time for which the plant is available.

16. It is felt that DEAT's recent submission that 'All existing plants will have to meet new plant standards within a period of eight years' is unrealistic.

    Recommendation: The definition of 'existing plant' should include those plants for which authorisation was obtained prior to the publication of emission standards.

    Recommendation: It is proposed that availability of resources, remaining life of the plant, and impact of plant emissions on the health of people living in the vicinity be taken into account when determining the period of time allowed for compliance of existing plant with new plant emission standards. It would be better to evaluate the time required on a plant-by-plant basis.

Eskom is committed to continued improvement in environmental performance, and would like to work with Government to achieve this objective. Emission reduction requires resource availability, particularly water in the case of SO_2 reduction, and often additional outages which would need to be approved by NERSA. Eskom is looking forward to working with stakeholders in order to minimize emissions.

Yours sincerely,

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